TEST ANXIETY AND EXAM-TAKING SKILLS AS MEDIATORS OF INFORMATION PROCESSING IN COLLEGE STUDENTS

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Cognitive-attentional test anxiety theory posits that test-anxious individuals direct attention internally, thus interfering with task-relevant information processing. Nevertheless, working-memory deficits are often obscured by compensatory exertion of increased effort by anxious subjects on cognitive tasks. Failure to identify anxiety-specific performance decrements has led some authors to replace the test anxiety construct with one emphasizing skill deficiencies. This investigation examined whether information-processing deficits are inherent sequelae of test anxiety or merely reflect lowered exam-taking ability in test-anxious persons.

High and low test-anxious college students with either good or poor exam-taking skills were evaluated in a dual-task paradigm. Under stress instructions, subjects alternately performed a primary task (Raven Advanced Progressive Matrices) separately and concurrently with a secondary task (backward Digit Span). It was hypothesized that high-anxious students with good exam skills would manifest no primary-task deficits

since exam-taking strategies assist attentional focusing. However, excessive allocation of attentional capacity here would leave little spare capacity for secondary-task solution. Conversely, it was predicted that high-anxious, unskilled students, lacking mechanisms to externally direct attention, would manifest performance deficits on both tasks.

Results were consistent with the above predictions. Exam-skilled, high-anxious students performed comparably with skilled, low-anxious peers on the Raven task, yet significantly worse on the concurrently completed Digit Span measure. High-anxious, unskilled subjects, on the other hand, were exceeded by low-anxious, unskilled peers on both primary and secondary tasks.

Overall, these findings suggest that test anxiety and exam-taking ability independently influence cognitive problem solving in evaluative settings. While good exam skills can compensate for anxiety-induced declines in working-memory capacity by outwardly redirecting attention, processing deficits emerge with increased task demands. Implications include the continued usefulness of the test anxiety construct and the potential subclassification of test-anxious individuals by exam-taking ability to greater individualize treatment interventions.

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TEST ANXIETY AND EXAM-TAKING SKILLS AS MEDIATORS OF INFORMATION PROCESSING IN COLLEGE STUDENTS

The pervasive influence of test anxiety upon both learning and performance in instructional settings has long been recognized by psychologists (Tobias, 1979). Indeed, investigations into the origin, nature, and treatment of test anxiety comprise a research tradition spanning over 30 years. Within the past decade, the specific information-processing difficulties of test-anxious individuals have received particular attention. Developments in a variety of hitherto-unrelated areas have provided the base for a comprehensive approach to test anxiety employing information-processing concepts.

That information-processing deficits in test-anxious persons arise from inadequate exam-taking strategies has been recently suggested (Kirkland & Hollandsworth, 1980). The current study explored the relative contributions of test anxiety and exam-taking skills to the emergence of such deficits in college students. Its intent was to identify subgroups of test-anxious individuals, based upon exam skill levels, with specific information-processing characteristics. The differentiation of distinct test-anxiety subtypes would demonstrate the importance of both test anxiety and exam-taking skills in mediating information processing. Moreover, it would hold direct implications for clinical intervention while providing a meaningful direction for future research in this area.

Historical Development of Test Anxiety Theory

Drive-Oriented Approaches

Test anxiety theory was originated by Mandler and S. Sarason (1952) as an attempt to explain the effects of anxiety upon performance on intelligence tests. This theory postulated that evaluative situations typically evoke two different sets of drives--"learned task drives" and "learned anxiety drives." Learned task drives arise in response to the particular demands of any task which an individual undertakes. They lead to response sequences which facilitate task completion, thus leading to eventual drive reduction. (Viewed another way, learned task drives might be equated with such constructs as "achievement motivation" or "mastery" drives.)

The second major class of drive elicited in test situations was termed "learned anxiety drives" by Mandler and S. Sarason (1952). These anxiety drives lead to two types of responses, "task-relevant" responses and "task-irrelevant" responses. Task-relevant responses are functionally equivalent to learned task drives in that they result in effective problem solution (despite differing intervening responses). Task-irrelevant responses, on the other hand, interfere with successful task performance. Mandler and S. Sarason stated that these task-irrelevant responses are "manifested as feelings of inadequacy, helplessness, heightened somatic reactions, anticipation of punishment or loss of status and esteem, and implicit attempts at leaving the test situation" (p. 166).

The primary research tool utilized by Mandler and S. Sarason in their investigation of test anxiety was the Test Anxiety Questionnaire (TAQ; S. Sarason & Mandler, 1952). The TAQ is a 37-item scale with a Likert format which measures the presence of task-irrelevant anxiety responses that hinder test performance. Employing this instrument to identify high and low test-anxious individuals, the authors and their colleagues examined the effects of instructions and feedback on task performance in these two groups.

S. Sarason, Mandler, and Craighill (1952) gave stressful, "ego-involving" instructions to high and low test-anxious college students on a timed digit-symbol task. Subjects were told that they would easily complete the task within the time limit when, in reality, solution within the alotted time was impossible (stressful instructions). Other high and low test-anxious subjects were informed that the task was difficult and that they would not be expected to finish (nonstressful instructions). Results indicated that the high test-anxious students attained higher scores under the low-stress instructions while the low test-anxious individuals worked better under stressful, ego-involving instructions. In a second experiment, high-anxiety students given ego-involving instructions ("intelligence test" description) made significantly more effors on the Kohs' Block Design

Test than a low-anxiety group given the same instructions. The arousal of task-irrelevant learned anxiety drives was offered by the authors as an explanation of the performance of the high-anxious group.

A similar study by Mandler and S. Sarason (1952) provided high and low test-anxious subjects with either "success" or "failure" feedback on a noncontingent basis following completion of digit-symbol and block-design tests. Both types of feedback hindered performance for anxious individuals on block design and facilitated subsequent performance for low-anxious subjects. Few effects emerged on the digit-symbol task. Feedback on task performance was interpreted as increasing task-irrelevant responses in high-anxiety subjects and task-relevant responses in low-anxiety subjects through elicitation of the hypothesized learned anxiety drive.

That internal attributions are associated with task-irrelevant responding was shown by Doris and S. Sarason (1955). After failing subjects on portions of several standardized intelligence tests, they asked participants to rank order possible causes of their poor performance on a continuum ranging from complete "self-blame" to "other blame". High test-anxious individuals tended to view their failures as self-caused while low test-anxious persons did not.

Although the preceding landmark studies were performed within the context of Mandler and S. Sarason's (1952)

Hullian drive formulation, their results held far-reaching implications for later approaches. Wine (1980) has pointed out that their demonstration of the interaction between evaluative stress and test anxiety has, by now, virtually assumed the status of an empirical law. Moreover, their focus upon the negative, self-centered responses of test-anxious persons predated later cognitive formulations.

The Mandler-Sarason theory of test anxiety (Mandler & S. Sarason, 1952) provided impetus for ensuing decades of related research. It also gave rise to several new test-anxiety instruments. Of particular interest is Alpert and Habers' (1960) Achievement Anxiety Test (AAT), developed to measure Mandler and S. Sarasons' incompatable task-relevant and task-irrelevant anxiety-mediated responses. The former are assessed by a nine-item "facilitating anxiety" scale while the latter are measured by a ten-item "debilitating anxiety" scale. Unlike that of Mandler and S. Sarason, however, Alpert and Haber's bi-dimensional theory assumes that a person may possess one or both types of anxiety in varying degrees. The AAT has seen extensive use through the past 20 years.

Another widely-used instrument is the Test Anxiety Scale (TAS) which was constructed by I. Sarason (1958) from TAQ items which had been converted to a true-false format. This 21-item inventory has undergone several revisions (I. Sarason, 1972; I. Sarason & Ganzer, 1962; I Sarason, Pederson, & Nyman, 1968) resulting in the current version containing 37 items (I. Sarason, 1972).

Other test-anxiety inventories include the Test Anxiety Scale for Children (TASC; S. Sarason, Davidson, Lighthall, Waite, & Ruebush, 1960), the Suinn Test Anxiety Behavior Scale (STABS; Suinn, 1969), and the Mathematics Anxiety Rating Scale (MARS; Richardson & Suinn, 1973). All of these instruments have been extensively used in test-anxiety research. A relatively new measure which is being increasingly employed in research is the Test Anxiety Inventory (Spielberger, 1980).

Another approach rooted in drive theory is Spielberger's (1966) trait-state anxiety theory. State anxiety (A-State) was defined by Spielberger (1972a) as a "...transitory emotional state or condition of the human organism that varies in intensity and fluctuates over time...characterized by subjectively, consciously perceived feelings of tension and apprehension, and activation of the autonomic nervous system..." (p. 39). Trait anxiety (A-Trait), conversely, was related to "...relatively stable differences in anxiety proneness, that is, to differences in the disposition to perceive a wide range of stimulus situations as dangerous or threatening and in the tendency to respond to threats with A-State reactions" (p. 39).

Within this framework, test anxiety is seen as a situation-specific form of trait anxiety (Spielberger, 1972b). High test-anxious individuals are thought to respond to evaluative situations with larger elevations of state anxiety (A-state reactions) than those persons low in test anxiety. Consistent with Mandler and S. Sarason's (1952) theory, both emotional reactions and self-centered "worry" responses are held to be present in test-anxious individuals. However, for Spielberger, task-irrelevant responses do not arise from cognitive self-rumination as much as from the energizing of competing (task-irrelevant) responses in the response hierarchy (Spielberger, Anton, & Bedell, 1976). Thus, the increment in drive associated with A-state reactions leads directly to "task generated" interference. Such a formulation is based primarily upon Spence-Taylor drive theory (Spence & Spence, 1966) and places greater emphasis upon the emotional versus the cognitive components of test anxiety.

To measure his two types of anxiety, Spielberger developed the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970). This instrument consists of two 20-item scales (STAI-Trait, STAI-State) designed to measure dispositional and situational manifestations of anxiety, respectively.

The fact that the reactions measured by the STAI are not depicted as linked to any specific situational cues has made it less well suited to test-anxiety research than the instruments discussed earlier. Nevertheless, high state anxiety has been shown to be associated with decrements in intellectual performance (Gross & Mastenbrook, 1980; Sieber, 1980; Spielberger, Gonzalez, Taylor, Algaze, & Anton, 1978). The hypothesized relationship between A-trait and A-state, however, has received more mixed support empirically (Heinrich, 1979; Van der Ploeg, 1979).

Consistent with predictions from drive theories of test anxiety, systematic desensitization has been widely utilized to lower the autonomic reactivity of such individuals. However, as will be seen later, treatments solely targeting arousal have effectively reduced anxiety levels but little influenced cognitive performance in the majority or research studies examining this issue (Allen, Elias, & Zlotlow, 1980). Such findings have suggested the necessity of considering cognitive as well as emotional factors in treating test-anxious persons.

The Worry-Emotionality Conceptualization

Liebert and Morris (1967) made an important contribution toward refinement of test anxiety theory when they distinguished between the "worry" and "emotionality" components of test anxiety. Previously, these two aspects of test anxiety had been grouped together by Mandler and S. Sarason (1952) as task-irrelevant responses elicited by the learned-anxiety drive.

From items of S. Sarason and Mandlers' (1952) Test Anxiety Questionnaire, Liebert and Morris (1967) constructed two 5-item scales, each apparently probing for qualitatively different subjective experiences in test-anxious individuals. The worry scale was composed of items associated with a person's cognitions such as self-doubt and negative expectation of success. Conversely, emotionality scale items dealt with autonomic, physiological and affective responses in testing situations (e.g., upset stomach, racing heartbeat). Utilizing these two scales, Liebert and Morris demonstrated that worry, but not emotionality, was related to performance deficits in test-anxious persons.

Worry and emotionality are also measured in the Inventory of Test Anxiety (Osterhouse, 1972) and Spielberger's (1980) recent Test Anxiety Inventory. Since their introduction, these terms have been widely adopted as operationally useful in component analyses of the construct of test anxiety.

Subsequent research has generally corroborated the strong relationship between the cognitive variable of worry with such performance criteria as examination grades (Deffenbacher, 1980; Doctor & Altman, 1969; Morris & Liebert, 1970) and experimental tasks (Deffenbacher, 1978; Morris & Fulmer, 1976). Moreover, worry is nearly always associated with lowered performance expectations (Deffenbacher, 1980). Conversely, results with the emotionality factor have been less conclusive as this has frequently been found to be unrelated to performance when the shared variance with worry is removed (Deffenbacher, 1977, 1980).

A recent review of the pertinent literature by Morris, Davis, and Hutchings (1981) confirmed the above findings and concluded that worry and emotionality are "...developed through different learning experiences that may or may not coincide for a given individual, and under the control of different situational stimuli that may or may not coincide in a given situation" (p. 552). Such a social-learning perspective can partially accommodate the fact that some persons experience worry without emotionality in the evaluative setting while others experience neither or both. In advocating a greater sensitivity to the person-situation interaction, these authors have highlighted the multidetermined nature of test anxiety phenomena.

The worry-emotionality dichotomy of Liebert and Morris (1967) provided a new direction for investigation into the underlying nature of test anxiety. It represented a tool to empirically test previously unquestioned assumptions about test-anxious individuals. Because of the research which it inspired, the formulation served as a link from earlier drive-dominated to later cognitive-attentional approaches.

Cognitive-Attentional Theory

Wine's (1971) review and resynthesis of the test-anxiety findings to that time marked the formal beginning of the cognitive-attentional approach to test anxiety. Succinctly stated, the Wine theory posited that the "highly test-anxious person responds to evaluative testing conditions with ruminative, self-evaluative worry, and thus, cannot direct adequate attention to task-relevant variables" (p. 99).

Although Wine's (1971) theory was consistent in many respects with that of Mandler and S. Sarason (1952), it adopted the Liebert-Morris (1971) worry-emotionality distinction and the hypothesized primacy of the cognitive component. For Wine, worry was considered to be "attentionally demanding" (p. 100), thereby interfering with the direction of attention toward a task. Autonomic arousal (emotionality), on the other hand, required little attention and did not disrupt problem-solving efforts. Only when an individual consciously focuses upon his or her physiological reactions will performance decrements occur. In support of her reformulation, Wine cited research suggesting that test anxious individuals had high levels of worry and self-preoccupation, manifested increased sensitivity to social-evaluative cues, and reduced the range of task cues to which they responded in problem-solving.

Wine's (1971) attentional approach held direct implications for the education and treatment of test-anxious persons. First, any manipulations which facilitated greater task focusing in such individuals (visual displays, provision of attentional strategies, etc.) should improve their task performance. Second, the hypothesized cognitive nature of the deficit in test anxiety argued for interventions aimed toward decreasing worry rather than emotional arousal. In this regard, Wine's theory advocated a major change from then-prevalent anxiety-reduction research and treatment paradigms to those utilizing cognitive procedures.

Since its introduction by Wine (1971), cognitive-attentional theory has derived support from several areas of research which may be roughly combined into two categories. The first is comprised of laboratory studies examining the basic learning and memory processes of test-anxious individuals. Such research will be presented in a subsequent section on information processing. The second line of research is concerned with assessing the relative contributions of the cognitive and physiological components of test anxiety to diminished performance.

Research directly measuring levels of worry and emotionality (Liebert & Morris, 1967) in test-anxious subjects provided initial support for a cognitive outlook. However, these studies were gradually supplanted by those employing designs directly comparing cognitive, relaxation/desensitization, or combined intervention procedures with test-anxious subjects. According to this approach, any differential effectiveness for cognition- and arousal-targeted therapies would imply similar differences in the respective involvement of cognitive and emotional factors in precipitating test-anxiety performance deficits.

Systematic desensitization (Wolpe, 1958) has undoubtedly been the most-studied intervention for test anxiety. Allen et al.'s (1980) review of the voluminous test-anxiety treatment research indicated that this technique reduced self-reported anxiety in experimental versus no-treatment control subjects in 77% of the studies surveyed. According to cognitive-attentional theory, however, little increase on intellectual and academic performance measures should result from such anxiety reduction while drive-based approaches would clearly predict the opposite. Consistent with Wine's (1971) attentional formulation, Allen and his colleagues reported improvement on performance measures in only 11% of the studies primarily employing desensitization.

In another review of 15 studies from the self-control literature Denney (1980) found that subjects' functioning on performance measures improved as intervention techniques increased their emphasis on cognitive restructuring. Cognitive coping techniques such as Goldfried's (1977) systematic rational restructuring and Meichenbaum's (1972, 1977) cognitive modification were effective in 70% of the studies examined, whereas self-control training techniques (Deffenbacher, & Snyder, 1976; Goldfried, 1971; Suinn & Richardson, 1971) and applied relaxation procedures (Denney, 1974; Russell & Sipich, 1973) improved cognitive performance in 50% and 33% of the studies, respectively.

The strongest support for a pure cognitive-attentional approach to test anxiety, perhaps, comes from studies in which attentional or cognitive procedures proved to be effective alone in anxiety reduction (Goldfried, Linehan, & Smith, 1978; Shaw, 1980; Wise, 1981) or when directly compared to combination (cognitive-anxiety reduction) treatments (Holroyd, 1976; Kaplan, McCordick & Twitchell, 1979; Wine, 1980).

Holroyd's (1976) is typical of the latter type of paradigm. He assigned test-anxious subjects to one of four conditions: rational-emotive therapy (RET), desensitization, combined RET-desensitization, or attention-placebo. Results revealed that subjects in all four conditions showed decreases in debilitating anxiety on the AAT compared to waiting-list controls. However, the cognitive therapy (RET) subjects declined the most in anxiety, outperformed all others on a digit-symbol task, and attained greater increases in grade point average the following semester.

The singular supremacy of cognitive treatments for test anxiety has not been the rule, however. Since Meichenbaum first demonstrated the utility of a combined (relaxation/cognitive restructuring) approach to test anxiety (Meichenbaum, 1972), multi-modal treatment formats have obtained the most consistent results in lowering anxiety and improving performance (see reviews by Allen et al., 1980; Denney, 1980; Di Tomasso, 1981; Lopez, 1976). In light of this, Wine's (1971, 1980) hypothesized functional equivalence between self-attention and test anxiety may have to bear closer scrutiny.

In summary, it has been demonstrated that a cognitive component is essential to an understanding of the nature of test anxiety. However, treatment research also suggests that an arousal component also exists, although tonic measures of autonomic arousal have been unsuccessful in isolating this potential facet of test anxiety (Holroyd & Appel, 1980). For example, Holroyd, Westbrook, Wolf, and Badhorn (1978) found no differences between high and low test-anxious women on three physiological (heart rate, skin conductance, skin resistance) measures during completion of an anagram and Stroop color-word task. Nevertheless, high-anxious subjects manifested higher anxious arousal on the STAI-State and poorer anagram performance than those low in test anxiety. This state anxiety, however, was nonsignificantly related to anagram performance ($\underline{r}$ = .27) although the presence of worry was strongly correlated ($\underline{r}$ = .80) with the anagram measure in high test-anxious subjects. These results were taken by Holroyd et al. as further support for both the cognitive nature of test anxiety and the lack of relationship between self-reported emotionality and the variables of cognitive performance and physiological arousal.

One interesting finding of Holroyd et al.'s (1978) study was the difference in heart-rate variability between the two anxiety groups. The greater heart-rate variability of low test-anxious subjects was associated with lower state anxiety and faster anagram solution. Such variability has been suggested as indicative of changes in attentional direction required for the efficient solution of complex problems (Montgomery, 1977). Congruent with cognitive-attentional theory this physiological measure may have provided direct evidence for increased task-relevant attentional focusing in low compared to high test-anxious individuals.

A major contribution of the Holroyd et al. (1978) investigation was its finding that self-report measures of arousal do not necessarily accurately portray internal autonomic events. Indeed, recent attribution experiments (Wilson, Hull, & Johnson, 1981) have also suggested that subjects frequently possess limited access to internal states. Rather, they may tend to base self-reports upon inferences drawn from other variables in such settings. Since much of the research discounting the role of arousal in test anxiety was based upon self-report measures of emotionality, a question is raised concerning the interpretation of such findings.

Several investigators have questioned the heuristic assumption that worry and emotionality, as measured by the Liebert and Morris (1967) scales, are relatively independent constructs (Finger & Galassi, 1977; Kaplan et al., 1979; Whitney, 1980). These two factors have been found to correlate as highly as .75 in several studies (Deffenbacher, 1980). In addition, worry and emotionality are influenced by cognitive and relaxation-based treatments alike (Deffenbacher, 1980).

A factor analysis of the Test Anxiety Scale by Richardson, O'Neal, Whitmore and Judd (1977) seriously challenged further the notion that two separate constructs are measured by worry and emotionality items in the TAS. They found that both worry- and emotionality-scale items loaded on the same factor. This factor was characterized by worry over (1) perceived performance in problem-solving and (2) all cognitive and physiological consequences of this worry. The second factor identified contained test items reflecting "emotional distress in testing situations" (p. 704) without accompanying performance interference of heightened autonomic arousal. These results suggest that emotionality responses may comprise a subclass of worry responses concerned with internal autonomic events in evaluative situations.

Deffenbacher (1980) has attempted to reconcile the discrepant research findings with worry and emotionality by suggesting that the lack of a differential impact by cognitive and relaxation treatments upon these components may result from mechanisms of action other than those which are theorized. For example, cognitive restructuring may reduce physiological arousal while relaxation therapies may reduce the level of ruminating worry.

Two recent studies demonstrate this latter point. In the first, D'Alelio and Murray (1981) administered a cognitive treatment identical to that of Holroyd's (1976). Significant treatment-group reductions in test anxiety were obtained, relative to controls, after eight weeks. However, no performance improvements were manifested on a verbal analogies test or in next-semester grade point average.

The second study (Leal, Baxter, Martin, & Marx, 1981) compared cognitive modification, modeled after treatments devised by Meichenbaum (1972) and Holroyd (1976), with desensitization and waiting-list control procedures. The two experimental groups met for six one-hour treatment sessions. Unexpectedly, arousal reduction through desensitization significantly improved performance on the Raven Standard Progressive Matrices (Raven, 1965b) but failed to lower state anxiety. Conversely, cognitive modification significantly reduced state anxiety but had no impact on the Raven performance measure.

In summary, unequivocal independence of cognitive and emotional variables in test anxiety remains to be demonstrated. The relationship between these two components may be more complex than our previous models have implied (Deffenbacher, 1980). Currently, there are indications that an attributional framework may better explain the interaction between worry and emotionality in test-anxious individuals (Geen, 1980). This approach will be examined in a later section.

The most fruitful potential area of further expansion for test anxiety research and theory lies in the field of information processing. Indeed, it will be seen that such a move represents a natural "next step" in fully developing the implications of the cognitive-attentional approach (I. Sarason, 1975).

Information Processing Theory and Test Anxiety

Self-Attention and Information Processing

Irwin Sarason has marshalled considerable evidence within a social-learning-theory perspective which favors the attentional approach to test anxiety (I. Sarason, 1972, 1975). Nevertheless, his most significant contribution may be the presentation of a model unifying cognitive-attentional theory with information-processing concepts. Like Wine (1971), I. Sarason (1975) emphasizes the extensive self-preoccupation of the test-anxious individual over perceived inadequacies. Within his information-processing analysis, this self-preoccupation interferes with attention to environmental cues and increases physiological arousal. This subsequently intensifies self-focusing, leading to disruption of informational encoding and transformation, eventually hindering the implementation of effective behavioral strategies. The resulting impaired performance gives rise to further negative self-evaluations serving to perpetuate the cycle. Self-rumination is, therefore, hypothesized to detrimentally influence all phases of the information-processing sequence (I. Sarason, 1975, p. 37).

Tobias (1977, 1979) has similarly delineated the stages at which anxiety interferes with the intake, storage, and retrieval of information in evaluative settings. He has referred to these stages as "preprocessing," "processing," and "postprocessing," respectively (Tobias, 1977, p. 575-576).

The increasing tendency to conceptualize self-attentional processes in informational terms is best emodied in Carver's (1979) recent reformulation of self-awareness theory (Duval & Wicklund, 1972). In this model, self-attention and its behavioral consequences are viewed as comprising a cybernetic negative feedback loop.

Self-focus in the presence of a salient behavioral standard automatically leads to a "matching-to-standard" of one's behavior with continuous testing of the match and subsequent closer approximation of one's behavior. When behavior is considered to match the standard, the entire sequence terminates. However, if the sequence is interrupted for any reason (e.g., if the behavior is difficult to execute) then an immediate "assessment" is made with two possible results. The first occurs when a person assesses his or her eventual probability of success (outcome expectancy) to be good, leading to positive affect and a return to the matching-to-standard sequence. The second occurs when subjective probability of success is low and leads to negative affect and withdrawal from the situation. In cases where no behavioral standard is apparent, however, an individual must compare his or her behavior with internally generated standards--for example, present physiological reactions or past history of behavior in similar contexts.

The Carver (1979) model is highly consistent with that proposed by I. Sarason (1975) in its implications for test anxiety theory. The negative self-focus which the test-anxious individual brings to the testing situation quickly detracts from the maximal use of task-relevant cues, leading to an assessment of outcome probability. However, the lowered success-expectancy held by such an individual precludes return to the matching-to-standard sequence. Rather, he or she attempts to withdraw from the situation. Since behavioral withdrawal (from the classroom) is not generally available, task-avoidant internal withdrawal is experienced. Yet, because such self-attention increases worry and heightens sensitivity to autonomic arousal, the internal focus of the test-anxious individual brings constantly-increasing feedback of inadequacy. This escalating sequence constitutes a positive-feedback loop characterized by behavioral paralysis and deficits in cognitive performance.

Although the Carver (1979) theory is comprehensive in its explanatory power, this very fact renders it less amenable to empirical test. Unlike Wine's (1971, 1980) theory, Carver's approach posits both positive and negative consequences for self-attention. Preliminary studies by Carver and his co-workers have been mildly positive (Carver & Blaney, 1977; Schier & Carver, 1981). Nevertheless, its application to the experimental study of test anxiety has produced mixed results (Slapion & Carver, 1981).

The withdrawal tendencies of high test-anxious students were apparent in an interesting study by Galassi, Frierson, and Sharer (1981). These investigators had students taking an actual course examination endorse the presence of positive and negative thoughts on a checklist measure. While the most endorsed negative cognition for high, medium, and low test-anxious groups concerned escape ("Wish I could get out or test was over." p. 58), more high and medium test-anxious individuals reported this thought (65% and 71.6%, respectively) than low test-anxious students (46.3%). Congruent with Carver's (1979) theory, removal from an "intolerable" situation may, thus, be a prominent ideation associated with negative self-attention.

The many parallels between the events described within the Wine (1971, 1980) and Carver (1979) self-attention theories and the phenomenon of "learned helplessness" (Abramson, Seligman, & Teasdale, 1978; Seligman, 1975) are obvious. Briefly, learned helplessness is a condition which is believed to occur when an organism learns that its responses no longer control outcomes to which it is subjected. Although four classes of symptoms can be manifested by helpless individuals, two are particularly relevant to test anxiety. The first is a motivational deficit which is characterized by behavioral passivity and decreased responding in problem-solving situations. The second is a cognitive deficit which is frequently manifested by diminished mental-task performance.

The possibility that a unitary process may underlie deficits observed in both test-anxious and learned-helpless persons has led to application of the learned-helplessness paradigm to the study of test anxiety. In one such experiment, Lavelle, Metalsky, and Coyne (1979) demonstrated that high test-anxious students were move vulnerable to helplessness induction than low test-anxious subjects. More recently, they have successfully employed an "attentional-redeployment" procedure to reverse helplessness deficits (Coyne, Metalsky, & Lavelle, 1980).

In summary, information-processing models are increasingly called upon to describe self-attentional states. However, these formulations are often excessively global at this stage of development. Much more may be gained at this time by integrating test anxiety concepts with the existing wealth of theoretical and experimental data in the information processing area with the subsequent experimental evaluation of hypotheses generated in this fashion. The next two sections will illustrate this approach.

Modern Theories of Information Processing

Kahneman's theory of attention. Although Kahneman's (1973) information-processing theory did not directly address the topic of test anxiety this formulation was an important influence upon modern information-processing theory and its application to our understanding of anxiety. Prior to Kahneman, "structural" models of information intake and storage had predominated in the basic-process perception/ learning literature. These structural approaches may be summarized in an over-simplified manner by stating that they searched for the "bottleneck" in a person's sequential processing of external input. It had previously been shown that an apparently absolute limitation existed on the amount of simultaneously presented information that an individual could process in entirety. The major question thus became whether this limiting element, or bottleneck, of the system was located early (Broadbent, 1958, 1971), or later (Deutsch & Deutsch, 1963) in processing.

Kahneman (1973) rejected the concept of an absolute, fixed limitation on informational processing in favor of one emphasizing an ever-changing capacity for such processing within an individual. In brief, he proposed that the effort or capacity required for completion of any task is at every moment limited. Nevertheless, this capacity is labile across situations and is directly dependent upon the demands of the immediate task (e.g., the more difficult the task, the greater the "effort" and capacity required for its completion). Arousal is also thought to covary with task difficulty. The amount of capacity available for problem-solving increases with arousal level at low to moderate levels, but decreases at high levels of drive. In this way, the inverted-U hypothesis (Yerkes & Dodson, 1908), relating arousal level to task performance, may be viewed as reflecting this changing availability of attentional capacity.

Applied to test anxiety, Kahneman's (1973) theory serves to provide a conceptual base for explaining Wine's (1971) conclusions. Wine had speculated that high test-anxious individuals reduce the range of cues to which they respond in problem solving. This is primarily a result of the hypothesized inward direction of attention. Nevertheless, the questions of how and under what conditions learning and performance decrements became manifest are not directly addressed by Wine's theory. Kahneman's model, however, explains that increased allocation of attentional capacity to a primary task, in turn, decreases the amount of "spare" capacity available for perceptual monitoring. Thus, the inward direction of attention in high test-anxious subjects may be considered a process which consumes attentional capacity which then becomes unavailable for external problem-solving efforts. Kahneman's theory also predicts that more difficult tasks will show a larger performance decrement than easier tasks owing to their greater capacity requirements. As will be seen, this outlook has received much support in recent research.

Other current information-processing models. Kahneman's (1973) capacity model of attention presaged numerous later refinements in information-processing theory. Schneider and Schiffrin (1977), in particular, have greatly expanded elements from the theories of Kahneman and others. These authors differentiated "controlled" processes which require expenditure of attentional capacity from "automatic" processes which require no investment of either effort or capacity (Kahneman's "serial" and "parallel" processes, respectively). They demonstrated that "divided attention deficits" arise when difficult material is presented in sufficient quantity to the processing system early in learning. Later in learning, however, as material becomes overlearned, automatic processes develop which require little capacity and are unaffected by memory-load factors.

The development of automatic processes is an especially important addition to Kahneman's (1973) theory made by Schneider and Schiffrin (1977). It directly implies that divided attention deficits should not occur in test-anxious subjects once material has become well learned. This component of the theory offers an interesting alternative to Mandler and S. Sarason's (1972) drive explanation for the improved performance of their high-anxiety subjects later in learning. Indeed, information-processing theory is well equipped to explain the myriad of results within the test-anxiety literature.

Hamilton (1975) also offered an interesting elaboration of Kahneman's (1973) theory and extension toward the explanation of anxiety-prompted performance deficits. He reasoned that a capacity model implies that successful performance on a task may only occur when "...APC + SPC = I_{ept} + I_{ist} where APC is average processing capacity, SPC is spare processing capacity, I_{ept} is externally presented primary task information and I_{ist} is internally generated secondary information" (p. 53).

In this scheme, anxiety is viewed as possessing both drive and informational aspects which result in internally generated cognitive interference. The internal variables in the above equation are further specified to account for task-relevant and task-irrelevant (competing) responses. Hamilton went on to apply his model to neurosis schizophrenia, and socialization anxiety. Though not widely adopted, his unification of drive theory and information-processing approaches represented a forward step in the search for a parsimonious conceptualization of the anxiety-performance relationship.

Hasher and Zacks (1979) have put forth a framework within which a broad range of experimental findings on memory performance might be integrated. They attempted to demonstrate through their own and others' research, that certain mental operations are invariably automatic in nature while others habitually require "effortful" processing. The processing of frequency, spatial location, temporal information, and the activation of word meanings are all considered to be automatic functions, requiring no conscious effort or use of attentional capacity. Conversely, the employment of imagery, mnemonic devices, rehearsal, and organizational strategies appears to be an effortful process which utilizes a portion (or all) of the attentional capacity available to an individual at a given time.

The second major facet of the Hasher and Zacks (1979) formulation is their hypothesis that high arousal, depression, and old age can all result in the loss of attentional capacity. This is manifested in studies showing the hindered performance of persons in these categories on tasks requiring effortful processing compared to persons not so classified. Moreover, aroused, depressed, and elderly individuals do not exhibit performance decrements on automatic tasks. Of particular importance in the present discussion is the authors' conclusion that both over- and under-arousal result in deficits in effortful problem-solving, one which is consistent with Kahneman (1973). Thus, test-anxious individuals would be expected to perform poorly under stress-incuding instructions while non-anxious subjects would be expected to perform better under high- rather than low-stress conditions. Indeed, S. Sarason et al.'s (1952) pioneering study attained this very result which has been replicated numerous times since (Deffenbacher, 1978; Wine, 1980).

From the above, it appears that a capacity theory of attentional allocation may be capable of integrating a wide range of data concerning individual differences in cognitive functioning. The specificity of constructs within this type of formulation also lends itself well to empirical test when applied to test anxiety.

The Nature of Cognitive-Attentional Deficits

Current laboratory investigations examining the interaction between test anxiety and basic learning and memory processes are chiefly extensions of an earlier research tradition exploring the relationship between drive and various facets of information processing. This line of inquiry is embodied in the work of Easterbrook who, in 1959, reviewed then-existing research and concluded that the state of physiological activation caused an individual to reduce the breadth of cues to which he or she responded in the environment. This attentional narrowing was found to lead to improved performance when the aroused individual was engaged in a "central" task , but poorer performance when he or she worked on "peripheral" tasks. When peripheral cues were essential to success on a central task, however, heightened drive was found to diminish performance on the central task. Another generalization of Easterbrook's was that, consistent with the Yerkes-Dodson law (Yerkes & Dodson, 1908), complex tasks were disrupted at lower levels of arousal than were more simple endeavors. The similarity of Easterbrook's conceptualization with that later developed by Kahneman (1973) is apparent. This continuity of thought from early to modern approaches suggests the enduring relevance of past research to current information-processing theory.

Support for a narrowed attentional focus in test-anxious persons has been cited from their lowered performance on peripheral reaction-time tasks (Wachtel, 1968) and their lesser use of both irrelevant (West, Lee, & Anderson, 1969) and beneficial (Geen, 1976) peripheral information in problem-solving. Such focusing has additionally been found to covary with the level of evaluative stress present in the situation (Geen, 1980).

In apparent contradiction of the above findings, Dusek and his co-workers (Dusek, Kermis, & Mergler, 1975; Dusek, Mergler, & Kermis, 1976) demonstrated that test-anxious grammar-school students performed less well on a central learning task in the presence of peripheral distracters than low test-anxious students. Moreover, on peripheral (incidental learning) tasks, the opposite took place. Another study by Nottlemann and Hill (1977) further found a greater degree of off-task behavior (resulting in lower anagram performance) in test-anxious 4th and 5th grade students.

How are such results to be interpreted within attentional theory? It may be posited that, for the above children, attendance to extraneous variables within the evaluative setting represented escape from an aversive situation. Whereas test-anxious adults may maintain an internal, task-irrelevant focus, children may initially seek environmental means of withdrawal. It is interesting that the redirection of attention in two of the above studies (Dusek et al., 1975; Dusek et al., 1976) through labelling of the central stimuli improved performance in high but not low test-anxious children. Such a result is entirely congruent with expectations from Wine's (1971) cognitive-attentional theory. That attentional training can improve the cognitive performance of test-anxious children has also been recently shown by Ribordy, Tracy, and Bernotas (1981).

Another productive line of research has been that followed by John Mueller and his associate (Mueller, 1980). Mueller has argued that the reduced cue-utilization of test-anxious individuals can be demonstrated through their "shallow" encoding of language input (Mueller & Courtois, 1980). From Craik and Lockhart's (1972) "levels of processing" theory Mueller reasoned that the superficial processing of such input by high-anxious subjects should interfere with memory performance. Evidence for this shallow processing would be seen in over-attention to physical features of words (such as rhyming) rather than semantic ("deep") features such as conceptual meaning.

Failure to properly encode language input is also thought to result from the decreased use of memory strategies, such as elaboration and clustering, in high-anxious subjects. It will be recalled that rehearsal strategies are among those functions thought to be hindered by the reduced effortful processing of high-anxious persons by Hasher and Zacks (1979). Therefore, experimental demonstration of strategy differences between high and low test-anxious individuals could support an attentional-capacity theory of test-anxiety deficits. Presumably, the internal allocation of attention would make capacity unavailable for more-extensive (or deep) encoding of semantic input.

Indeed, evidence is gradually accumulating for elements of the above formulation. A 1976 experiment by Mueller found that, on a free-recall task, high-anxious subjects tended to cluster list items by taxonomic (conceptual) category, acoustic similarity (rhyming) and associative relationships much less than did low-anxious subjects. Mueller explained this as a reduced sensitivity to incidental cues in the learning situation with a relatively greater focus upon physical versus semantic stimulus features.

Other researchers have also obtained related findings fitting within attentional theory. Dey (1978) reported facilitated anagram performance for anxious subjects when only one conceptual category was present, but deteriorated performance when 2, 3, or 4 categories were included. This difficulty in division of attention among several relevant classifications was manifested despite prior subject knowledge of the categories involved. Michaud (1980), in a list-learning paradigm, additionally found high test-anxious subjects recalled fewer words and used fewer taxonomic categories in learning than low test-anxious subjects.

Other studies by Mueller and his colleagues (Mueller, Carlomusto, & Marler, 1977; Mueller, Carlomusto, & Marler, 1978) have, nevertheless, questioned whether a simple shallow versus deep processing explanation is adequate to explain high-anxiety processing deficits. In these studies, subjects were administered word lists which could be grouped by either associates or rhymes. The only difference in clustering between high and low test-anxious groups emerged in the former subjects' failure to incorporate peripheral (rhyming) cues into their encodings when given additional time, as did low test-anxious subjects. Thus, some rigidity in the use of encoding strategies may exist in highly anxious students (Mueller, 1978; Mueller & Courtois, 1980). This speculation is congruent with the reduced variability in attentional allocation in the problem-solving of test-anxious individuals reported elsewhere (Holroyd et al., 1978).

Closer examination of one class of tasks (digit span) employed in Mueller's research reveals qualitative differences which can be related to newly-developing information-processing concepts. Forward and backward digit-span retention tasks, such as those utilized on the Wechsler Adult Intelligence Scale (Wechsler, 1958), have frequently been used in the study of attentional-capacity deficits (Baddeley, 1981). Baddeley and his associates have termed the locus of such deficits, "working memory" (Baddeley, 1981; Baddeley & Hitch, 1974). Working memory is believed by these authors to be a capacity-limited temporary storage depot in information processing. It serves as the functional unit in which attention is voluntarily allocated during problem solving.

In much of Mueller's research, however, digit-span tasks have often produced mixed experimental results (Mueller & Courtois, 1980; Mueller & Overcast, 1976; Mueller et al., 1978).

Although the forward or backward nature of the digit-span tests is typically not specified, high test-anxious subjects recalled significantly fewer backward, but not forward, digits than low test-anxious individuals in at least one case (Mueller et al., 1978). Kennelly and his colleagues (Hayslip & Kennelly, in press; Kennelly, Crawford, Waid, & Rahaim, 1980) have suggested a scheme within which the above result may be understood. Their research has demonstrated the unique sensitivity of backward- compared to forward-digit-span tasks to attentional-capacity deficits. These authors have, therefore, speculated that the repitition of digits in a backward direction is an active, transpositional process which uses a portion or all of available working-memory capacity. The reproduction of digits in a forward direction, however, seems to be an "automatic" process, involving passive span of apprehension, which utilizes little working memory space. This novel distinction may eventually be an important step in the evolution of tasks which target specific cognitive processes. Moreover, such an interpretation is highly consistent with Hasher and Zacks' (1979) formulation while providing further evidence for a deficit in the effortful-processing capabilities of high test-anxious individuals.

Two additional experiments by Mueller (1978) are of interest to cognitive-attentional theory. In the first, high and low test-anxious subjects were administered a word list containing items which were capable of being clustered by either alphabetic or conceptual category.

Before the list was given, however, one third of the subjects engaged in a semantic "orienting task" (labeling words in a list as "pleasant" or "unpleasant") while another third worked on a non-semantic task (labeling first letters of words as vowels or consonants). The remaining third of the subjects received no pre-treatment. Results showed improved recall for high-anxiety subjects receiving semantic rather than the non-semantic pre-treatment. No effects for the orienting tasks on recall in the low-anxious subjects were found as this group performed identically with the no-orientation controls. Measures of conceptual and alphabetic clustering, however, revealed few effects for the orienting tasks.

In the second experiment reported by Mueller (1978), high and low test-anxious subjects recalled fewer words following a non-semantic orienting task, but increased their usage of rhyme clustering. Conversely, a semantic-orienting task increased recall and associative clustering but decreased rhyme clustering. It may be assumed that these orienting tasks served an attention-directing function, alleviating the anxiety-induced processing deficits. The fact that such orienting tasks are not always successful with such subjects, however, may indicate that longstanding rehearsal strategies are resistive to easy change (Mueller & Courtois, 1980).

In summary, several tentative conclusions may be drawn from the data presented in this section. Highly anxious individuals appear to be less adept than low-anxious persons on free-recall tasks and give evidence for the decreased use of the more complex memory-encoding strategies. In particular, anxiety seems to interfere with the utilization of salient cues in some learning situations such that certain deeper stimulus features are ignored. Thus, such individuals show a preference for "maintenance" versus "elaborative" rehearsal strategies (Mueller & Courtois, 1980, p. 459). The observed neglect of peripheral cues is consistent with an attentional capacity view of test-anxiety deficits. Test-anxious persons narrow their attentional field by turning their focus inward. This results in reduced attentional capacity for effortful, information processing.

Toward a Comprehensive Theory of Test Anxiety

The increasing covergence of previously divergent theoretical areas promises to increase our understanding of test-anxiety phenomena. Nevertheless, the fact that information-processing theories generally employ an arousal construct, at first glance, appears to contraindicate their relevance to a cognitive-attentional view of anxiety. Mueller (1980), however, has recently pointed out that the existence of an attentional bridge between test anxiety and memory/information-processing research does not preclude the continuing importance of earlier findings from drive theory (Spence & Spence, 1966). He speculated that the attention component might best be considered as a supplement to, rather than a replacement for, drive theory. Such a "multiprocess framework" (p.65) could serve to explain the frequently contradictory results in laboratory research on memory and anxiety.

Deffenbacher (1980) has stressed the need to maintain a balanced perspective in conceptualizing and treating test anxiety. In a summary of worry-emotionality research, he concluded that the predicted relationships between cognitive therapy and relaxation-based treatments and worry and emotionality, respectively, have not been supported empirically. Thus, both cognitive-attentional and arousal components of test anxiety should still be addressed in treatment packages.

A provocative discussion by Geen (1980) offers an interesting unification of cognitive and arousal-based approaches. Geen cited preliminary research suggesting that two distinctive arousal states may accompany emotional and cognitive activity. The former is associated with an autonomic, tonic activation which seems to be situation-specific and arising as a "transient response to situational stressors" (p. 55). The latter, or "cognitive arousal" (p. 55) is phasic, associated with high levels of worry, and often a response to self-perceived changes in somatic (emotional) arousal.

Following from the work of Schachter and Singer (1962) and Weiner and Samuels (1975), Geen (1980) proposed an attributional formulation. Test-anxious individuals are considered to have an enduring disposition toward self-deprecatory worry in stressful situations (I. Sarason, 1972), whereas low test-anxious individuals do not. Under conditions of evaluative stress, however, both experience emotional arousal from the threat of negative evaluation. High test-anxious persons, though, are thought to additionally respond to such stress with dominant worry responses, leading to a state of cognitive arousal. When occurring together, these cognitive and emotional arousal states result in the condition of state anxiety which is debilitating to subsequent cognitive performance.

For low test-anxious individuals, however, heightened emotional arousal does not elicit worry responses and thus cognitive arousal is avoided. Such persons may attach the label "interest" (p. 56) to their aroused state.

Although highly tentative, Geen's (1980) approach represents a compatible merger of the Spielberger (1972) and Wine (1971, 1980) positions, while uniting both with information processing theory. Consistent with cognitive-attentional theory, Geen's conceptualization adopts the same view of internal events of test-anxious persons (e.g., negative self-focus). Yet, it goes beyond this view in speculating why arousal formulations have been unable to empirically relate emotional reactivity to cognitive performance. As an intervening construct "cognitive arousal" offers a link between attentional processes and the drive variables inherent in information-processing formulations. If Geen's (1980) theory has merit, it may ultimately be shown that an individual's meaning system interacts in complex fashion with physiological factors in determining his or her capacity for problem-solving in evaluative situations.

The Current Study

Statement of the Problem

Previous sections have demonstrated the strong association between test anxiety and cognitive performance deficits. Nevertheless, an emerging issue within the field of test-anxiety research is whether the term still has merit as a theoretical construct. In her most recent statement, Wine (1980) commented that "test anxiety" implied a heightened autonomic arousal which research has shown need not be present in test-anxious individuals (Hollandsworth, Glazeski, Kirkland, Jones, & Van Norman, 1979; Holroyd & Appel, 1980; Holroyd et al., 1978). Instead, she proposed the phrase "evaluation anxiety: a cognitive-attentional construct" (Wine, 1980, p. 351), to describe the internally-generated cognitive interference experienced by such persons.

Wine's (1980) attempt to further shift the focus of test-anxiety toward its "worry" or cognitive component is highly consistent with both her earlier review (Wine, 1971) and the preponderance of the literature just cited.

As such, it seems to represent an evolution of prior test anxiety concepts and theories rather than a break with prior theorizing concerning test anxiety.

A much sharper change in out thinking is advocated by Kirkland and Hollandsworth (1979, 1980). These authors, in noting the seemingly ubiquitous presence of skill deficiencies in test-anxious individuals, have postulated that a poverty of adequate study habits and examination-taking behaviors is central to their performance decrements. Evidence for such a formulation comes chiefly from reports citing lower levels of study and exam skills in high versus low test-anxious subjects (Bruch, 1981; Culler & Holahan, 1980; Disderato & Koskinen, 1969; Kirkland & Hollandsworth, 1979; Wittmaier, 1972).

Based upon their findings, Culler and Holahan (1980) suggested a re-interpretation of Wine's (1971) interference model to take into account possible differences between high and low test-anxious students in their familiarity with test material. They speculated that a student's realization of her or her ill-preparedness might significantly contribute to the emergence of worry in the examination setting. Such a process has also been hypothesized by Benjamin, McKeachie, Lin, and Holinger (1981).

More-indirect support for the study-skills approach is found in the frequent inability of anxiety-reduction procedures to improve the performance of test-anxious subjects on such measures as cognitive laboratory tasks, classroom examinations and grade point averages (see reviews by Allen et al., 1980; Denney, 1980; Di Tomasso, 1981). For example, in a recent investigation by Kirkland and Hollandsworth (1980), subjects given a "skills acquisition" treatment manifested greater improvement in GPA and on anagram performance tasks than individuals administered cue-controlled relaxation, meditation, or practice-only sessions on anagrams. Similar differences emerged on measures of effective test-taking and attentional interference.

The above studies notwithstanding, other researchers have discovered study-skills counseling by itself to be ineffective in either lessening test anxiety (Cornish & Dilley, 1973; McCordick, Kaplan, Smith, & Finn, 1981; Mitchell and Ng, 1972) or improving academic performance (Allen, 1971; Horne & Matson, 1977; Mitchell & Ng, 1972; Osterhouse, 1972). Indeed, reviews by Anton (1976), Denney (1980), and Allen et al. (1980) have all concluded that combined treatment formats consisting of both anxiety-reduction procedures and study-skills training may be most effective in reducing both the heightened anxiety and performance deficits of test-anxious persons.

Most recently, a meta-analysis of 75 therapy outcome studies with test-anxious students by Di Tomasso (1981) identified cognitive treatments and multi-modal interventions as superior to either relaxation/desensitization procedures or study-skills training in improving grade point average and anagram performance. Consistent with the reports of other authors, Di Tomasso also reported that relaxation/ desensitization treatments were most effective in reducing self-reported anxiety. Thus, study-skills training alone was not found to be a preferred treatment mode in either alleviating test anxiety or facilitating cognitive performance when compared to other procedures. This fact does not bode well for Kirkland and Hollandsworth's (1980) suggested replacement of the term "test anxiety" with "ineffective test-taking" (p. 438).

A closer examination of Kirkland and Hollandsworth's (1980) procedure reveals confusion in the definition of their "skills acquisition" treatment, which was divided into three areas. Congruent with most study-skills training paradigms, the first area concentrated upon instruction in exam-related behaviors (surveying length, returning to harder items later, etc.). However, the second two components, "adaptive self-instruction statements" and "attentional-control skills" were actually cognitive-therapy interventions adapted from the work of Meichenbaum (1972, 1977) and Wine (1980). In light of this, Kirkland and Hollandsworth's skills-acquisition condition better resembled a cognitive multi-modal treatment than it did pure study-counseling procedures. The apparent failure to isolate test-taking instruction from self-instruction/ attentional-redirection training makes tenuous any conclusion based upon a single component alone of the three-part treatment package. It also precludes the study's addressing Wine's (1980) assertion that study-skills training by itself does not affect "...the major cognitive characteristics of test anxious persons, i.e., negative self-preoccupation, and attention to evaluative cues to the detriment of task cues." (p. 371).

In summary, it may be premature to deny the existence of "test anxiety" as a valid construct. This seems to remain an empirical question which must be answered experimentally. Several writers in this area (Galassi, et al., 1981; Meichenbaum & Butler, 1980; Wine, 1980) have recently warned against the adoption of Kiesler's (1966) "patient uniformity myth" in describing test-anxious individuals. High test-anxious persons may differ among themselves as much as they do from low test-anxious persons (Meichenbaum & Butler, 1980; Wine, 1980). Moreover, clinical experience amply suggests the existence of test-anxious individuals who possess adquate ability, motivation, and study skills, yet who panic within the examination setting (I. Sarason, 1980; Meichenbaum & Butler, 1980). (Pre-med or pre-professional students often fall within this category.) A theory based entirely upon hypothesized skill deficiencies in test-anxious persons is unable to either adequately describe or assist such students.

One alternative to the above dilemma would be to view the behavioral manifestations of test anxiety (e.g., impaired cognitive performance) as universally resulting from attentional deficits within the evaluative situation (Wine, 1971, 1980). From this perspective, individual differences among test-anxious individuals would emerge in the types of behavioral and cognitive events precipitating these deficits. Thus, Kirkland and Hollandsworths' (1980) formulation would be well-suited to describe a subgroup of test-anxious persons whose poor study- and exam-taking skills increase worry which hinders proper focusing upon task-relevant variables. But, it would less-adequately describe individuals possessing such skills whose task-irrelevant processing is brought on by fear of failure, lowered self-confidence, or unrealistic academic or career goals. Within this framework, the former subgroup of students might be considered "skills-deficient" while the latter would comprise a truly "test-anxious" subgroup. Although study-skills and exam-taking instruction may benefit both types of individual, the "test-anxious" student may require a more-personalized intervention strategy if the source of his or her self-deprecatory cognitions is to be altered. Thus, Meichenbaum and Butlers' (1980) call for the delineation of test-anxious subtypes is important from both theoretical and practical standpoints.

Contributing to the oversimplification of our view of test-anxious individuals has been the relative neglect of basic-process research in this area. Wine (1980) has called for a transition from currently popular treatment paradigms back to those allowing us to study underlying events which mediate changes on performance measures. It may be found that our test-anxiety interventions work for quite different reasons than we generally assume (Deffenbacher, 1980). Currently, information-processing approaches have much to offer in this respect (Meichenbaum & Butler, 1980; I. Sarason, 1980; Wine, 1980).

M. W. Eysenck (1977, 1979) has been an influential investigator in applying information-processing principles to the study of anxiety-related learning and memory deficits. His examination of the literature resulted in the following reformulation:

> In essence, it has been argued that anxiety generates task-irrelevant processing activities which pre-empt some of the available effort and capacity of working memory. Although this aspect of anxiety inevitably reduces processing effectiveness, there is frequently little or no effect of anxiety on performance efficiency due to compensatory effort. Thus, it will typically be the case that comparability of performance of high and low-anxiety subjects is achieved at greater subjective cost to the high anxiety subjects, a fact that will be obscured if reliance is placed on performance measures. (Eysenck, 1979, p. 378-379)

In his review, Eysenck cited 12 dual-task studies where high- and low-anxious subjects performed comparably on a primary task, yet where the former group manifested decrements on a secondary task.

Eysenck's (1979) capacity theory is similar to those mentioned earlier, yet has particular relevance to the elucidation of the relationship between anxiety and study skills. It may be speculated that, in studies where study-skill counseling or exam-taking training improves the cognitive performance of high test-anxious individuals, the active mechanism is the redirection of attention from internal processes or task-irrelevant variables back toward the primary task. When performance equivalence between high and low test-anxious individuals is achieved in this way, such treatments serve as vehicles for increasing the attentional capacity available for problem-solving. However, the over-compensatory effort exerted by some high test-anxious subjects expends valuable attentional capacity which is then unavailable for more complex processing or the performance of additional attention-requiring tasks. Moreover, when task difficulty or evaluative pressure is severe enough, the increased effort-expenditure of the high test-anxious individual may not even be enough to insure success on the primary task, leading to cognitive disorganization and behavioral paralysis.

In summary, it is proposed that study skills and organizational strategies may be potent mediators of attentional focusing, and thus cognitive efficiency. Nevertheless, the absence of such strategies cannot be construed to be isomorphic with the phenomenon of test anxiety. Other variables such as task difficulty, degree of effort expended, ability, and situational stress also affect the information-processing capabilities of test-anxious subjects. Moreover, certain personality attributes (e.g., achievement motivation) may differentially influence working memory, thereby contributing to ultimate success or failure on cognitive tasks (Eysenck, 1979).

From the above, it is plausible that the phenomenon of test anxiety is an end point with numerous potential determinants. Greater clarification of these multilevel processes may facilitate the identification of test-anxious subgroups. Ultimately, this may lead to a classificatory nosology which will allow us to better recognize and meet the needs of each test-anxious individual.

Purpose of the Present Study

It is clear that the experimental designs of past studies have often obscured the differences among test-anxious persons. They have combined subjects of divergent study or exam-taking skills and failed to consider the compensatory effort exerted by many test-anxious individuals when faced with a single task. Furthermore, the frequent use of "crystallized" as opposed to "fluid" criterion measures has likely produced results reflecting differences in learning prior to evaluation.

(Horn and Cattell, 1966, have defined "crystallized" abilities as those overlearned intellectual processes which reflect educational/socio-cultural influences and "fluid" abilities as those biologically-determined processes of reasoning and abstraction which are relatively unaffected by environmental events.) Classroom examinations, for example, may assess a student's acquisition of knowledge in history or psychology without requiring the capacity-limited effortful processing (Hasher & Zacks, 1979) discussed earlier. Such capacity limitations become readily apparent, however, when high-demand new-learning tasks are introduced (Logan, 1978).

The current study sought to examine the performance of low and high test-anxious subjects, with either equivalent or disparate exam-taking skill levels, on primary and secondary tasks requiring effortful processing. The investigation had several goals. First, it attempted to demonstrate the existence of two subgroups of test-anxious individuals based upon their possession or lack of adequate test-taking strategies. (Kirkland and Hollandsworth, 1979, have demonstrated that measures of student knowledge of appropriate exam-taking behaviors are better predictors of academic performance than those assessing study skills.) The identification of a highly test-anxious sample of students who, nonetheless, possess a high level of exam-taking proficiency would seriously challenge the characterization of test anxiety as merely a skills deficit (Culler & Holahan, 1980; Kirkland & Hollandsworth, 1979, 1980). It would additionally suggest the feasability of devising treatment regimens for test-anxious persons which target specific symptoms according to individual needs.

Second, this study attempted to examine whether high test-anxious persons with good exam-taking abilities do engage in comparably-efficient problem solving with their low test-anxious counterparts. Evidence for such would support Eysenck's (1979) conclusions and confirm the clinical observation of "anxious performers"--students who, through extensive overlearning, narrowing of attention, and increased effort, perform well on tests of cognitive function. Such individuals may still experience considerable autonomic arousal and cognitive interference, yet have learned how to cope with these processes in the examination setting.

An attentional-capacity formulation would predict, however, that skilled test-anxious persons should manifest declining secondary-task performance with increasing primary-task difficulty while low-anxious peers continue to function efficiently. High test-anxious subjects with poor test-taking skills, on the other hand, should perform at a lower level on both primary and secondary tasks since, in the absence of attentional-focusing strategies, they are overwhelmed by external task requirements. Moreover, their paucity of available capacity would be especially evident on secondary-task items paired with more difficult primary-task problems. Low-skilled, test-anxious students might also be expected to engage in significantly greater self-rumination and task-irrelevant processing. It is this "skills-deficient" subgroup which is most often isolated in test-anxiety research (e.g., Mitchell & Ng, 1972).

A final goal of the present study was to further examine the test-taking cognitions of test-anxious individuals. Although the negative, self-deprecatory nature of their thoughts has been well documented (Wine, 1971, 1980), the potential mediating influence of exam-taking skills upon these cognitions has largely been ignored. The possession of adequate test-taking strategies may provide even the highly test-anxious person with a greater sense of self-efficacy (Bandura, 1977) in the evaluative setting.

Hypotheses

Following from the above discussion, these specific hypotheses were formulated.

1. High test-anxious subjects with good exam-taking skills will perform similarly with low test-anxious subjects possessing comparable skills on a primary task of moderate difficulty.

2. Both high and low test-anxious subjects with good exam-taking skills will perform significantly better on a primary task than high and low test-anxious subjects with poor exam-taking skills.

3. Low test-anxious subjects with good exam-taking skills will perform significantly better than all other

subjects on a secondary task of moderate difficulty completed concurrently with a primary task.

4. High test-anxious subjects with good exam-taking skills will also perform significantly better than high test-anxious subjects with poor exam-taking skills on a secondary task completed concurrently with a primary task.

5. With increasing primary-task difficulty, high test-anxious subjects possessing poor exam-taking skills will manifest significantly greater decrements in concurrent secondary-task performance than all other groups.

6. With increasing primary-task difficulty, high test-anxious subjects possessing good exam-taking skills will manifest significantly greater decrements in concurrent secondary-task performance than low test-anxious subjects with equal skills.

7. High and low test-anxious subjects with good exam skills will report significantly less cognitive interference during task completion than high and low test-anxious subjects with poor exam-taking skills.

Method

Subjects

Sixty-four undergraduate students (21 males, 43 females) in psychology courses at a large southwestern university participated in the current investigation for extra course credit. These individuals were chosen from 250 students who volunteered to take part in a study looking at "...thoughts and feelings about taking tests" (Appendix A). The term "test anxiety" was purposely omitted throughout the study to avoid providing subjects with an attributional label for subjective experiences during exam taking which they did not already possess.

The pretest sample was administered the Test Anxiety Scale (TAS; I. Sarason, 1972), which was unlabeled, and the Exam Behavior Scale (EBS) of the Effective Study Test (Brown, 1975). Following pretesting, persons scoring above 20 on the TAS were classified as "high test-anxious" whereas those with TAS scores below 15 were identified as "low test-anxious." These cutoff socres were found to approximate those used to select high and low test-anxious subjects, respectively, in other studies (Deffenbacher, 1978; Galassi et al., 1981; Mueller, 1978).

Subsequent to classification as high or low test-anxious subjects were further characterized as possessing "good exam-taking skills" if their EBS scores exceeded 20 and "poor exam-taking skills" if their scores fell below 19. These cutoff scores closely resembled the 75th and 25th percentile points, respectively, in Brown's (1975) normative college sample. They also fell within the top and bottom quartiles, respectively, in the current pretest sample.

Based upon the above criteria, each qualifying student was then assigned by a colleague of the author to one of four conditions: Low Anxiety/Poor Skills, High Anxiety/Poor Skills, Low Anxiety/Good Skills, and High Anxiety/Good Skills.

Individuals within these conditions were contacted and invited to participate in the second phase of the study. This resulted in four groups of 16 subjects whose ages primarily fell in the 18 to 22 range. Table 1 presents means and standard deviations of these subjects on the TAS and EBS pretest instruments.

Table 1

Group Means and Standard Deviations on the TAS and EBS Measures

Test Anxiety	Exam Skills	
	Poor	Good
	Test Anxiety Scale[a]	
Low		
M	10.12	10.19
SD	3.14	3.19
High		
M	24.69	24.06
SD	3.63	3.80
	Exam Behavior Scale[b]	
Low		
M	17.56	22.87
SD	.89	.88
High		
M	17.37	22.81
SD	.88	.83

Note: *n* = 16 for each group.

[a]Maximum score = 37

[b]Maximum score = 25

Design

The author and an advanced-level psychology doctoral student served as experimenters who were both blind to the conditions in which their subjects had been placed. All participants were individually given stress-inducing instructions and then administered the State form of the State-Trait Anxiety Inventory (STAI-S; Spielberger et al., 1970), followed by the first 20 items of Set II of the Raven Advanced Progressive Matrices (Raven, 1965a). For half of the Raven problems, subjects were required to retain in memory a six-digit number presented prior to the problem's exposure. Upon completion of the item, the digit sequence was repeated by the subject in reverse order. On the other half of the Raven matrices, the backward Digit Span task was completed prior to presentation of the Raven problem. When the two tasks above were finished, subjects completed the Cognitive Interference Questionnaire (CIQ; I. Sarason, 1978) and a Debriefing Instrument constructed by the author for this study.

Independent Measures

Test Anxiety Scale. I. Sarason's (1972) Test Anxiety Scale (Appendix B) is a 37-item self-report instrument of true-false format which measures anxiety that is specific to the testing situation. It has seen extensive research use and correlates highly with other test-anxiety inventories (Kirkland & Hollandsworth, 1979; I. Sarason, 1978). The TAS has also been found to correlate -.31 with ACT scores and -.33 with undergraduate GPAs (Kirkland & Hollandsworth, 1979).

Exam Behavior Scale. Brown's (1975) Effective Study Test (ETS) is composed of five scales assessing skills related to academic performance. Correlations of .54 and .57 between the ETS total score and undergraduate GPAs are reported by Brown. However, Kirkland and Hollandsworth (1979) have shown the 25-item Exam Behavior Scale to be a better predictor of GPAs and ACT scores than any of the other individual ETS scales or the ETS total score. The importance of test-taking knowledge to academic achievement has led to use of the EBS to measure the "skills" variable in test anxiety research (Kirkland & Hollandworth, 1980).

Dependent Measures

State-Trait Anxiety Inventory. The State portion of the State-Trait Anxiety Inventory (Spielberger et al., 1970) is a 20-item scale designed to measure the heightened arousal manifested in the A-State reaction. On the STAI-S, respondents are asked to rate the extent to which they agree with statements describing how they feel "at this moment" (e.g., "I feel calm", "I am upset"). The STAI-S has been widely used in test anxiety research as a measure of situational emotionality (Allen et al., 1980).

Primary task. The first 20 items of Set II of the Raven Advanced Progressive Matrices (Raven, 1965a) were utilized as the primary task. This instrument is characterized as "...a nonverbal test of intellectual efficiency with which, at the time of the test, a person is able to form comparisons between figures and develop a logical method of reasoning" (p. 1). According to its author, the Raven Matrices assesses the clarity of a person's thought processes without regard for educational factors. The fact that the Raven is an engaging, challenging, novel exercise requiring considerable effortful processing, thus, made it an ideal task for the present purpose. Other studies have also employed this test as a performance measure in investigating test anxiety deficits (Leal et al., 1981; Meichenbaum, 1972).

The Raven appears to target cognitive processes closely related to Horn and Cattells' (1966) "fluid" intelligence (Hunt, 1980). Moreover, since test items are arranged in order of increasing difficulty, this instrument allows for the direct measurement of the effects of accelerating primary-task work load upon secondary task performance. Indeed, Hunt (1980) has successfully utilized the Raven within a dual-task paradigm with a motor-vigilance test as the secondary task. The unique suitability of the dual-task procedure for examing capacity-limited processing activities has frequently been cited (Eysenck, 1979; Hunt, 1980; Kerr, 1973).

Secondary task. A backward Digit Span test similar to that of the Wechsler Adult Intelligence Scale (Wechsler, 1955) served as the secondary task. As previously discussed, such number series are routinely utilized in the study of working memory (Baddeley, 1981). The active processing required to reorganize and reverse a digit series, however, makes this task more difficult than mere reproduction in a, forward direction (Hayslip & Kennelly, in press; Kennelly et al., 1980). The dissimilarity of the Digit Span task to the Raven Matrices additionally provides for competition between primary and secondary tasks for a general attentional capacity rather than specific mental structures. Hunt (1980) has pointed out the desirability of this restriction in dual-task paradigms evaluating capacity limitations.

Six digits were presented at the rate of one per second on all trials since this had been shown to be a memory load of moderate difficulty which seemed to be sensitive to momentary fluctuations in working-memory capacity (Kennelly et al., 1980). Moreover, pilot work by the present author had discovered the backward Digit Span measure to be deleteriously influenced in high test-anxious subjects with increasing Raven item difficulty, further suggesting the utility of this task for the current endeavor. In lieu of pass-fail scoring, an interval-scale scoring system was developed in the pilot study wherein a score of zero to six was assigned for each digit series based upon the number of digits in correct position (Appendix C).

Cognitive Interference Questionnaire. The CIQ (Appendix D; I. Sarason, 1980) is an 11-item instrument on which subjects rate on a five-point scale, the degree to which they experience task-irrelevant thoughts during problem-solving activities. Sarason and Stoops (1978) have shown that high test-anxious subjects achieve higher CIQ scores under evaluative instructions than high test-anxious individuals given neutral instructions, or low test-anxious subjects given either type. This Questionnaire, increasingly used in test-anxiety research (e.g., Kirkland & Hollandsworth, 1980), shows promise in helping to differentiate the cognitive processes of subgroups of test-anxious persons in evaluative settings.

Debriefing Instrument. This Instrument (Appendix E) was designed by the current author and consists of six Likert-type items which are intended to measure subjects' reactions to the dual-task procedure. Specifically, it investigates subject attitudes toward each task, memory strategies employed, and relative amount of effort expended for the performance of the two tasks.

Procedure

Once seated across from the examiner in the experimental room, subjects were given evaluative-stress instructions designed to maximize their motivation and involvement in subsequent problem solving. These instructions were as follows:

> In a moment, you will be given a test which has been found to be related to intelligence in college students. It is important to this study that you do your very best on this test.

Following this statement, subjects were administered the STAI-S according to standardized instructions (Spielberger et al., 1970).

Next, the primary and secondary tasks were alternately presented either separately (S) or concurrently (C) such that each subject was exposed to 10 trials of the Matrices alone, 10 trials of the backward digits alone, and 10 trials simultaneously combining the two tasks. In order to counterbalance for the increasing difficulty of the Raven Problems, two sequences of presentation were made, alternating by subject;

Item	1	2	3	4	5	6	7	8	9	10
Sequence 1	C	S	C	S	C	S	C	S	C	S
Sequence 2	S	C	S	C	S	C	S	C	S	C
Item	11	12	13	14	15	16	17	18	19	20
Sequence 1	C	S	C	S	C	S	C	S	C	S
Sequence 2	S	C	S	C	S	C	S	C	S	C

Directions for all subjects were identical and adapted from the Raven Advanced Progressive Matrices Manual (Raven, 1965a). Four practice matrices from Set I were initially given with the instructions:

> This is a test of observation and clear thinking. Before we start the section that counts, we'll go through a few practice problems so that you can get the hang of how they work. (The first problem of Set I was displayed at this time.) The top part of Problem 1 has a piece cut out of it. Look at the pattern, think what the missing piece must be like to complete the pat-

tern correctly, both lengthwise and sideways and find the piece out of the eight pieces shown below. Only one of these pieces is perfectly correct. You can see that number one completes the pattern correctly downwards but is wrong the other way. Number four is correct along, but is wrong downwards. Put your finger on the piece which is correct both ways. (Subject complies.) Right. The correct answer is number eight. (If subject's response was inaccurate, correction was made by the experimenter with explanation.) Now, I want you to try Problem 2 by yourself and point to your answer once you've decided. (Correction again given for incorrect responses. Problems 3 and 4 were similarly administered.)

Subjects successfully completing three out of the four sample items proceeded to the next section of the experiment. Those who missed more than one practice problem were given additional problems until a 75% success rate was obtained, or until 12 problems were administered. No participants failed to meet this criterion.

After the Raven practice items, the Backward Digit Span task was introduced with these instructions:

Before you work on each problem, I am going to be giving you a set of tape-recorded numbers which I want you to repeat back to me in reverse order. For example, if I say 4-6-8, what would you answer? Good. Now, for some of the problems, I'll want you to say the reversed numbers right away and then work on the problem. But, on other problems, I'll want you to hold on to the numbers until you've finished the problem. You'll know when I want you to hold a number set in your head because I'll say, "I want you to remember this one". Just remember to point to the correct answer as soon as you finish a problem. Do you have any questions? Okay, let's try a few so that you can get used to doing them. (Two S trials and two C trials were then presented utilizing items from Set I of the Raven Advanced Progressive Matrices. Subjects who did not meet the criterion of recalling 75% of the digits given in these four trails were dropped from the experiment. Seven individuals were eliminated in this fashion.)

Following the practice trials, subjects were alternately required to work on the Raven and Digit Span tasks either separately or concurrently according to the schedule presented earlier. In each case, the experimenter issued the prompt, "The number is," when the digits were not spontaneously reproduced by the subject.

After completion of the dual-task procedure, the CIQ was introduced with the following statement:

I am interested in learning about the kinds of thoughts that go through people's heads while they are working on tasks such as these. The following list includes

> some thoughts you might have had while doing the tasks that you've just completed. Please indicate approximately how often each thought occurred to you while working on these tasks by placing the appropriate number in the blank provided to the left of each question.
>
> (Adapted from I. Sarason, 1980, p. 10)

Next, the Debriefing Instrument was presented with the following instructions:

> These are several questions concerned with how you viewed and approached the tests which you just did. Please circle the number above the answer which best describes how you feel about each statement.

Upon completion of the Debriefing Instrument, further informal feedback was solicited from subjects who were then given a short explanation of the study's goals and dismissed.

Results

Preliminary analyses examined the potential influence of the two experimenters upon the dependent variables. Three-factor (Test Anxiety x Exam Skills x Experimenter) analyses of variance (ANOVAs) were performed on the Raven, backward Digit Span (separate and concurrent presentation modes), CIQ, and State Anxiety measures. Summary tables of these unweighted-means ANOVAs are presented in Appendices F through J.

All ANOVAs produced nonsignificant main effects for the Experimenter factor. Moreover, two- and three-way interactions between this factor and the Test Anxiety and Exam Skills factors also failed to reach significance, with the exception of a marginally significant triple interaction, F (1, 56) = 4.10, $p < .05$, which emerged on the CIQ. This unexpected finding holds little theoretical significance and might best be interpreted as a chance effect. The fact that the two experimenters saw highly unequal numbers of subjects in two conditions resulted in discrepant cell means which may have given rise to a spuriously significant ANOVA effect. Support for this speculation comes from the observation, that, when the two examiners saw approximately the same number of subjects within any condition, comparable cell means were virtually identical. In view of the overall absence of experimenter effects in the preceeding analyses, data from each experimenter were combined in subsequent statistical treatments.

Prior to univariate analyses, a two-factor (Test Anxiety x Exam Skills) multivariate analysis of variance (MANOVA) was performed on total scores on the Raven, Digit Span (separate and concurrent presentation modes), CIQ, and State Anxiety instruments (Appendix K). Significant multivariate main effects appeared for both Test Anxiety, F (5, 56) = 6.18, $p < .001$, and Exam Skills, F (5, 56) = 2.91, $p < .025$. The interaction between Exam Skills and Test Anxiety was nonsignificant, F (5, 56) = 1.04, $p > .10$. Univariate analyses of the dependent variables will now be presented in separate sections.

Primary Task

Mean Raven scores and standard deviations for subjects within each condition are presented in Table 2.

Table 2

Means and Standard Deviations on the Raven Task[a]

Test Anxiety	Exam Skills	
	Poor	Good
Low		
M	15.00	14.94
SD	2.19	3.66
High		
M	12.00	14.12
SD	4.27	2.68

Note. Maximum score = 20.

[a]*n* = 16 for each condition.

Total Raven scores were analyzed in a 2 x 2 (Test Anxiety x Exam Skills) ANOVA (Appendix L). Results indicated a significant main effect for Test Anxiety only, F (1, 60) = 5.56, $p < .05$. The main effect for Exam Skills and the interaction between these two factors failed to reach significance, F (1, 60) = 1.57, $p > .10$; F (1, 60) = 1.58, $p > .10$, respectively.

Ideally, within the dual-task paradigm, the secondary task exerts little backward influence on the primary task, though this ideal is seldom realized (Hunt, 1980). Raven scores were, therefore, further examined as a function of whether individual Raven items were performed spearately or concurrently with the secondary Digit Span task. A 2 x 2 x 2 (Test Anxiety x Exam Skills x Presentation Mode) ANOVA, with repeated measures on the last factor, was computed on total Raven scores (Appendix M). No significant main effect for Presentation Mode, F (1, 60) = 1.72, p > .10, or interactions between this and the Test Anxiety and Exam Skills factors emerged, F (1, 60) < 1; F (1, 60) = 1.73, p > .10, respectively. The triple interaction was similarly non-significant, F (1, 60) = 3.14, .05 < p < .10.

Thus, it appears that the Raven matrices were generally considered to be of primary importance by most subjects with the Digit Span task being seen as an additional, yet, subordinate measure. This suggests that subjects performed the secondary task utilizing "spare" attentional capacity not expended in processing the primary Raven task.

Hypothesis 1 stated that high and low test-anxious subjects with good exam skills should obtain comparable total Raven scores. Planned one-tailed t-test comparisons showed that, as predicted, these two groups performed equally-well, t (30) < 1, presumably due to the overcompensatory effort exerted by the former subjects. Conversely, high test-anxious students with poor exam skills were surpassed by their low test-anxious counterparts, t (30) = 2.52, p < .01.

Hypothesis 2 was similarly evaluated through planned one-tailed *t*-tests. This hypothesis posited that high and low test-anxious students with good exam-taking skills would perform better than high and low test-anxious students with poor exam skills. Only partial support was received for this hypothesis, however. As expected, high-anxious, exam-skilled subjects exceeded high-anxious, unskilled individuals, t (30) = 1.70, $p < .05$. Yet, the presence of good versus poor exam-taking skills did not differentiate low test-anxious subjects, t (30) < 1.

Secondary Task

Table 3 presents means and standard deviations of total backward digits recalled on separate and concurrent presentation trials within each condition. These results are also presented graphically in Figure 1.

A 2 x 2 x 2 (Test Anxiety x Exam Skills x Presentation Mode) ANOVA on total Digit Span scores (Appendix N) revealed significant main effects for Test Anxiety, F (1, 60) = 10.10, $p < .005$, and Exam Skills, F (1, 60) = 5.48, $p < .05$. The main effect for Presentation Mode was nonsignificant, F (1, 60) = 1.95, $p > .10$. The Test Anxiety x Presentation Mode interaction was similarly nonsignificant, F (1, 60) = 2.84, $.05 < p < .10$, as were all remaining interactions (all Fs < 1).

A planned contrast demonstrated that, as predicted in Hypothesis 3, low test-anxious subjects with good exam-taking skills were superior to all other groups combined, F (1, 60) = 15.13, $p < .001$, under the concurrent task-presentation mode. Moreover, consistent with expectations from an attentional-capacity formulation, high test-anxious, exam-skilled subjects recalled significantly fewer digits than low test-anxious exam-skilled students in the concurrent condition, t (30) = 2.12, $p < .025$ (one-tailed).

Table 3

Means and Standard Deviations on the Digit Span Task[a]

Test Anxiety	Exam Skills	
	Poor	Good
Low		
Separate Mode		
M	53.75	57.62
SD	7.00	2.22
Concurrent Mode		
M	54.75	57.06
SD	6.44	4.68
High		
Separate Mode		
M	50.75	54.75
SD	5.01	4.42
Concurrent Mode		
M	48.75	51.44
SD	9.18	9.64

Note. Maximum score for 10 trials = 60.

[a]*n* = 16 for each condition.

Contrary to Hypothesis 4, anxiety was the chief mediating variable on the concurrent secondary task. High-anxious indi-

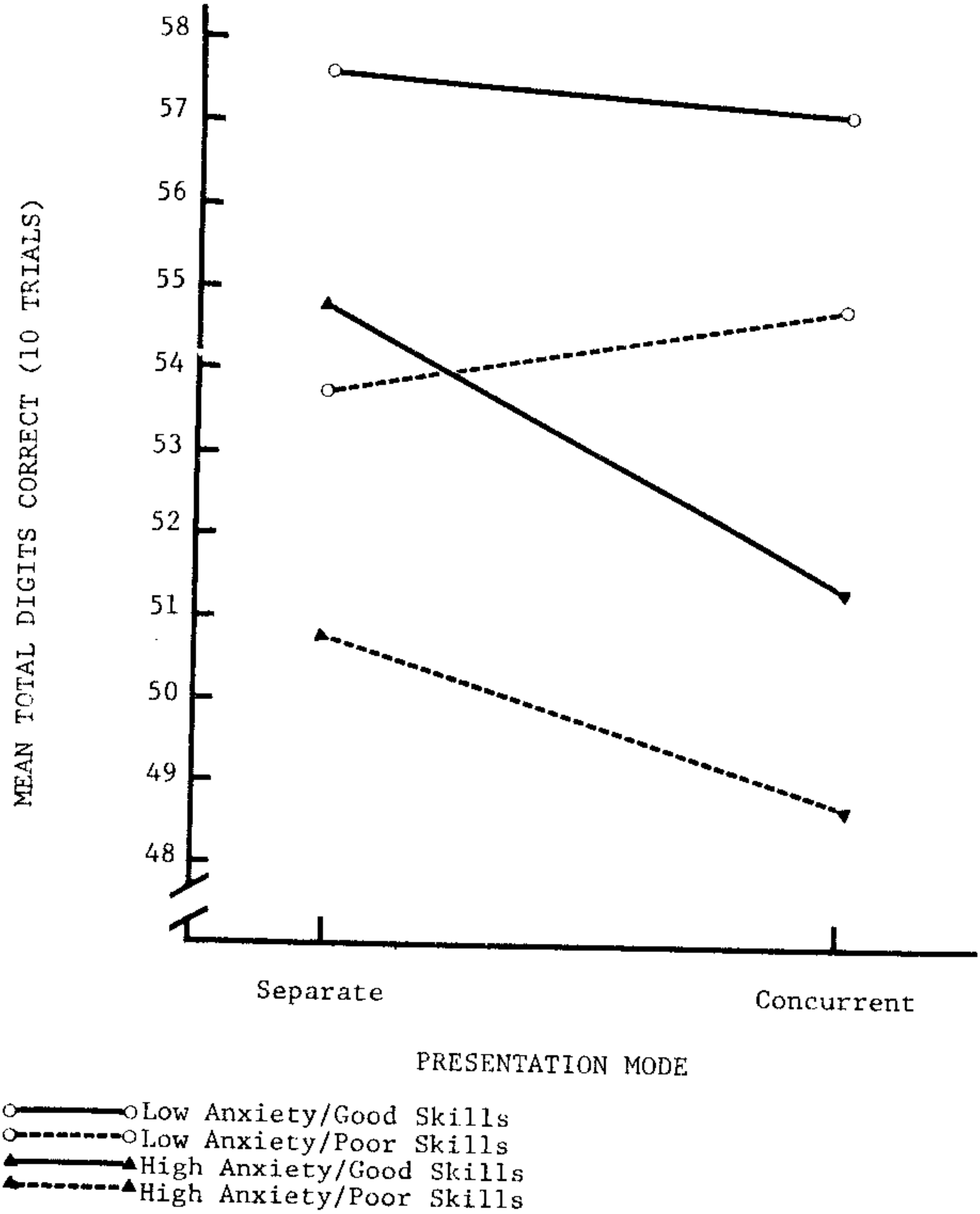

Figure 1. Mean digits retained by high and low test-anxious subjects with good and poor exam skills in the separate and concurrent presentation modes.

viduals recalled comparable numbers of digits in the good and poor exam-skills conditions, t (30) < 1, while low test-anxious subjects performed equally well in the good and poor skills groups, t (30) < 1.

Although the Test Anxiety x Presentation Mode interaction fell short of significance, high test-anxious subjects with both good and poor exam skills remembered significantly fewer total digits on concurrent versus separate trials, t (15) = 1.81, p < .05; t (15) = 1.83, p < .05, respectively, on one-tailed t tests. No differences emerged for skilled and unskilled low test-anxious subjects across the two presentation methods, t (15) < 1. Thus, increased processing load had a particularly negative effect on individuals with high levels of test anxiety.

To further examine the influence of increasing primary task difficulty upon secondary task performance, a difference score was computed for each subject between the Digit Span scores on adjacent S and C trials (1 & 2, 3 & 4...19 & 20). The 10 difference scores thus obtained were then collapsed into five blocks, each representing a group of four consecutive Raven items. Figure 2 schematically depicts difference scores for each group across the five trial blocks.

Total group difference scores were subsequently analyzed in a 2 x 2 x 5 (Test Anxiety x Exam Skills x Trial Block) analysis of variance with repeated measures on the last factor. Results of this ANOVA (Appendix O) revealed no significant

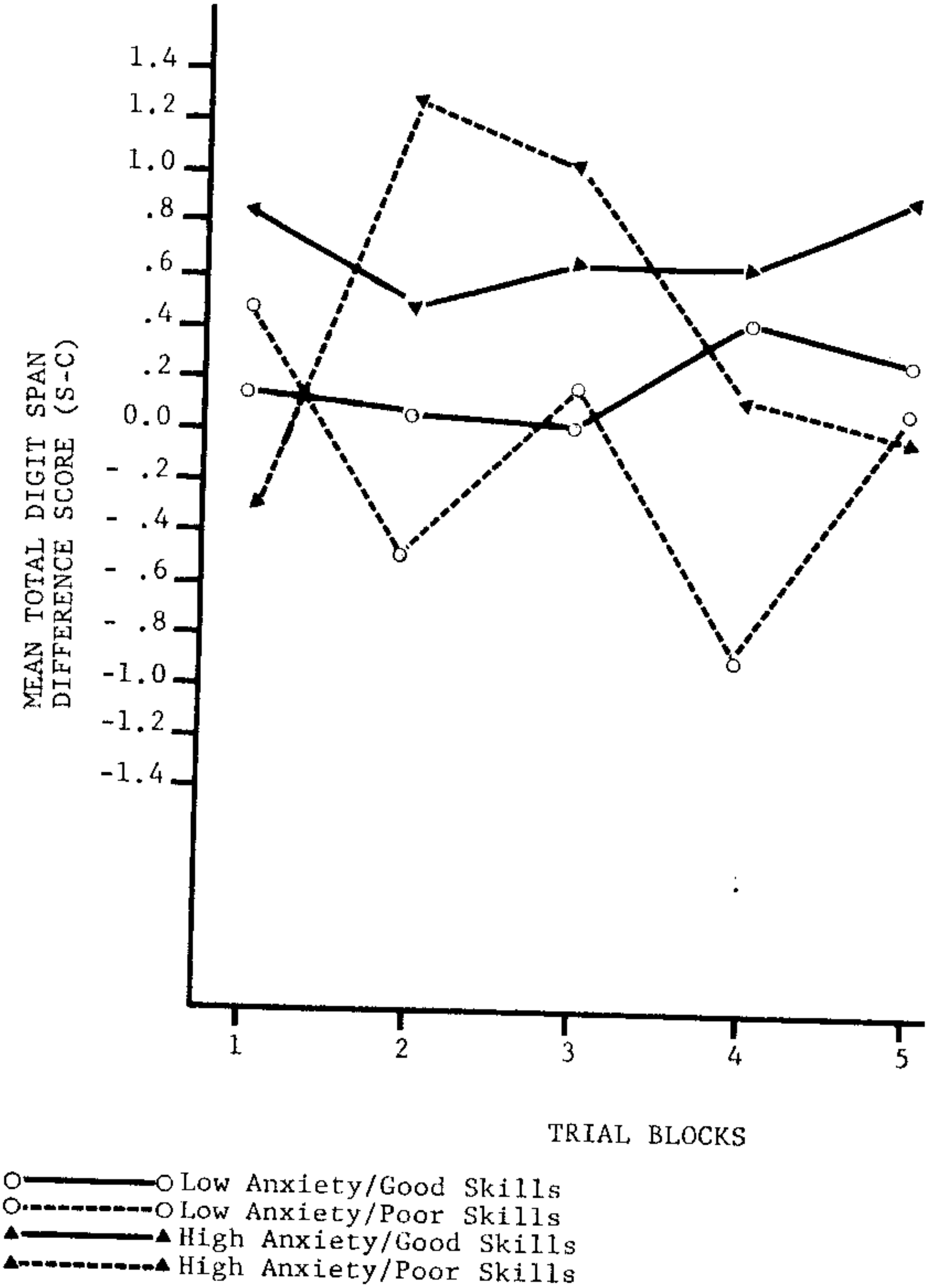

Figure 2. Mean Digit Span difference scores for high and low test-anxious subjects with good and poor exam skills across the five trial blocks.

main effects for the Test Anxiety, Exam Skills, or Trial Block factors, $\underline{F}$ (1, 60) = 2.52, $\underline{p}$ > .10; $\underline{F}$ (1, 60) < 1; $\underline{F}$ (4, 240) < 1, respectively. Moreover, the Test x Exam Skills, Test Anxiety x Trial Block, Exam Skills x Trial Block, and Test Anxiety x Exam Skills x Trial Block interactions were all nonsignificant, $\underline{F}$ (1, 60) < 1; $\underline{F}$ (4, 240) = 1.09, $\underline{p}$ > .10; $\underline{F}$ (4, 240) < 1; $\underline{F}$ (4, 240) = 1.58, $\underline{p}$ > .10, respectively. This indicates that performance on the concurrently completed secondary task did not increasingly deteriorate in linear fashion as the primary task became more difficult. Hypothesis 5 had stated that high test-anxious subjects with poor exam-taking skills would show the largest decrements in concurrent secondary-task performance of all groups while hypothesis 6 stated that high-anxious, exam-skilled subjects would manifest greater declines than low-anxious, skilled students. Neither hypothesis was supported by this analysis.

Cognitive Interference Questionnaire

Means and standard deviations on the CIQ for subjects in each condition are given in Table 4. Total CIQ scores were analyzed in a 2 x 2 (Test Anxiety x Exam Skills) ANOVA (Appendix P). Significant main effects emerged for both Test Anxiety, $\underline{F}$ (1, 60) = 12.32, $\underline{p}$ < .001, and Exam Skills, $\underline{F}$ (1, 60) = 6.56, $\underline{p}$ < .05. The two-factor interaction was not significant, $\underline{F}$ (1, 60) < 1.

Table 4

Means and Standard Deviations on the CIQ[a]

Test Anxiety	Exam Skills	
	Poor	Good
Low		
M	28.87	24.94
SD	5.95	6.75
High		
M	34.94	30.44
SD	7.07	6.53

Note. The higher the mean, the greater the degree of negative self-focus.

[a]n = 16 for each condition

Consistent with Hypothesis 7, both low and high test-anxious subjects with good exam skills had fewer distracting thoughts than their unskilled counterparts, t (30) = 1.75, $p < .05$; t (30) = 1.87, $p < .05$, respectively (one-tailed tests). Nevertheless, the presence of high test anxiety, in itself, was associated with a significantly higher number of self-deprecatory, task-irrelevant thoughts during performance of the Raven and Digit Span tasks. High-anxious, unskilled subjects reported more cognitive interference than both skilled and unskilled low test-anxious individuals, t (30) = 2.62, $p < .01$; t (30) = 4.09, $p < .0001$, respectively, while high-anxious, skilled students indicated more distracting thoughts than low-anxious individuals possessing similar exam skills, t (30) = 2.10, $p < .025$.

Interestingly, high test-anxious students with good exam skills and low test-anxious students with poor exam skills had comparable CIQ scores, t (30) < 1. This suggests that test anxiety may cause students who are skilled in test-taking to experience the same degree of worry and self-doubt as low-skilled students who are not test-anxious.

State-Trait Anxiety Inventory

Table 5 presents means and standard deviations on the STAI-S. It would be expected that stress-inducing instructions given prior to performance of effortful cognitive tasks should especially increase the self-reported arousal of high test-anxious individuals. To evaluate this possibility, a two factor (Test Anxiety x Exam Skills) ANOVA was computed on total STAI-S scores of subjects in each condition (Appendix Q). Consistent with the above expectation, a significant main effect for Test Anxiety emerged, F (1, 60) = 9.20, p < .005, with the Exam Skills main effect and the two-way interaction failing to reach significance, F (1, 60) < 1.

Post hoc two-tailed t tests demonstrated that high test-anxious subjects with poor exam skills experienced more situational arousal than low test-anxious students with either poor or good exam skills, t (30) = 2.60, p < .025; t (30) = 2.63, p < .025, respectively. High test-anxious students with good exam-taking ability did not significantly differ from their low test-anxious counterparts, however, *t* (30) = 1.62, *p* > .05. Nevertheless, as anticipated, mean state anxiety scores of the former subjects did tend to be higher than the latter individuals.

Table 5

Means and Standard Deviations on the STAI-S[a]

Test Anxiety	Exam Skills	
	Poor	Good
Low		
M	31.50	31.87
SD	8.74	7.96
High		
M	39.37	36.31
SD	8.18	7.54

[a]*n* = 16 for each condition.

Analysis of Related Variables

Debriefing Instrument. Means and standard deviations of subject ratings on the six items of the Debriefing Instrument are presented in Table 6. A 2 x 2 (Test Anxiety x Exam Skills) ANOVA was performed on total group scores for each item of the Debriefing Instrument. Results of these ANOVA's are presented in Appendices R-W.

Item 1 required subjects to rate the relative difficulty of the Raven and Digit Span tasks. Analysis of variance produced a significant interaction between Test Anxiety and Exam Skills, F (1, 60) = 13.85, p < .001, while main effects for Test Anxiety and Exam Skills did not reach significance,

Table 6

Means and Standard Deviations on the Six Debriefing Instrument Items

Item No.	Low Anxiety/ Poor Skills	High Anxiety/ Poor Skills	Low Anxiety/ Good Skills	High Anxiety/ Good Skills
	Experimental Condition[a]			
1				
M	$4.12_{a,b}$	$4.06_{a,b}$	3.19_{a}	4.44_{b}
SD	1.86	2.08	1.11	1.55
2				
M	4.38	3.81	4.62	4.38
SD	.72	1.11	.89	.81
3				
M	$4.56_{a,c}$	3.69_{b}	4.75_{c}	$3.88_{a,b}$
SD	1.10	1.14	1.06	1.20
4				
M	6.00	5.75	6.19	5.88
SD	1.03	1.06	1.38	1.54
5				
M	4.19	4.50	4.25	4.69
SD	1.68	1.82	1.48	2.00
6				
M	2.62_{a}	5.12_{b}	3.12_{a}	4.12_{c}
SD	1.20	1.45	1.54	1.15

Note. Means within the same row with different subscripts differ significantly on post hoc, two-tailed *t* tests at the $p < .05$ level or greater. No post hoc tests were performed on rows with no subscripts since results of preliminary ANOVAs were nonsignificant.

[a]*n* = 16 for each condition.

Post hoc two-tailed *t* tests revealed that high test-anxious subjects with good exam skills rated the Digit Span task more difficult than the Raven problems when compared to low test-anxious students with equal skills, $t(30) = 2.62$, $p < .025$. No other significant differences emerged in any other comparison. This implies that skilled, high-anxious students expended attentional capacity on the primary task, making the secondary task more difficult for them. The other three experimental groups, however, did not differ from one another in their appraisal of the two tasks.

In Item 2, subjects were asked to rate how well they did on the Raven problems compared to other study participants. The ANOVA on this item produced no main effects for either Test Anxiety, $F(1, 60) = 2.96$, $p > .05$, or Exam Skills, $F(1, 60) = 3.34$, $p > .05$. Moreover, the interaction of the above two factors was also nonsignificant, $F(1, 60) < 1$. This finding is not unexpected since, for the primary Raven task, it is assumed that subjects should generally have been able to expend the necessary effort for solution of the matrices. As anticipated, high-anxious, unskilled subjects, not compensating well for their heightened anxiety, tended to rate themselves lower on the Raven task than did subjects in the other conditions.

Item 3 was similar to Item 2, but required self-rating on the Digit Span task. This ANOVA revealed a significant main effect for Test Anxiety, F (1, 60) = 8.97, $p < .01$. The main effect for Exam Skills, F (1, 60) < 1, and the interaction between the two factors, F (1, 60) < 1, failed to attain significance. Post hoc two-tailed t tests showed that, consistent with their report on Item 1, high test-anxious subjects with good exam skills believed that they did worse than peers on the Digit Span task when compared to assessments made by low test-anxious peers with equal skills, t (30) = 2.18, $p < .05$. Two-tailed t tests also revealed that high test-anxious subjects with poor exam skills also rated themselves lower on Digit Span than did low-anxious individuals with either poor or good exam-taking skills, t (30) = 2.06, $p < .05$ and t (30) = 2.72, $p < .025$, respectively. These findings suggest that high test-anxious students were keenly aware of their deficient performance on the secondary task.

Subjects were asked in Item 4 how frequently they used rehearsal strategies to retain the backward digits on concurrent-presentation trials. The ANOVA on this item failed to produce significant F values for either Test Anxiety and Exam Skills main effects or for the interaction of these variables, all F's < 1. This indicates that subjects in all groups utilized strategies to remember the digits while working the Raven matrices. However, differences in the actual numbers of digits retained in this condition (presented earlier) by high and low test-anxious subjects indicate that the former may not adopt strategies which are maximally effective or are inefficient in applying those strategies which they do employ.

Item 5 required subjects to rate the relative difficulty of retaining the digit-span series in the separate versus the concurrent trials. No significant ANOVA results were produced for this item with respect to Test Anxiety and Exam Skills main effects, F (1, 60) = 2.16, p > .10; F (1, 60) < 1, respectively, or the two-factor interaction, F (1, 60) < 1. However, consistent with their lower digit retention scores in the concurrent condition, high test-anxious subjects manifested a tendency to rate this condition as more difficult than that in which the two tasks were performed separately.

The ANOVA on Item 6 (self-rating of anxiety during testing) revealed a significant main effect for Test Anxiety, F (1, 60) = 26.92, p < .001, and a significant interaction between Test Anxiety and Exam Skills, F (1, 60) = 4.94, p < .05. The main effect for Exam Skills was nonsignificant, F (1, 60) < 1. As anticipated, two-tailed t tests demonstrated significantly higher levels of self-reported anxiety for unskilled, high test-anxious subjects compared to individuals in the low-anxiety/poor skills, low anxiety/good skills, and high-anxiety/good skills groups, t (30) = 5.29, p < .001; t (30) = 3.77, p < .005; t (30) = 2.16, p < .05, respectively. Moreover, skilled, high test-anxious subjects also experienced more anxiety than low test-anxious students with poor and good exam skills, t (30) = 3.60, $p < .005$; t (30) = 2.07, $p < .05$, respectively. Such results are not surprising and again highlight the predilection for high test-anxious persons to label as "anxiety" their subjective internal states during testing.

Grade point average. Because individuals with good exam-taking skills possess adequate strategies for academic efforts, it was expected that this would be reflected in their school achievement. Self-reported grade point average was, therefore, obtained from each subject (see Table 7). (Benjamin et al., 1981, have found that students accurately report their GPA in research studies.) A 2 x 2 (Test Anxiety x Exam Skills) ANOVA was performed on total group GPAs (Appendix X).

As anticipated, a significant main effect for Exam Skills emerged, F (1, 48) = 6.93, $p < .05$, with other effects not achieving significance, Fs (1, 48) < 1. Of particular interest are the comparable GPAs attained by high and low test-anxious students possessing good exam skills, t (24) < 1, suggesting that compensatory mechanisms do indeed assist some high test-anxious students in their academic efforts. Other post hoc t (two-tailed) tests additionally suggest that good exam skills are more valuable in high than low test-anxious students. Skilled, test-anxious individuals exceeded their unskilled, test-anxious peers, t (24) = 2.73, $p < .05$, while possession of good versus poor exam skills did not differentiate low test-anxious students.

Table 7

Means and Standard Deviations of Student Grade Point Averages

Test Anxiety	Exam Skills	
	Poor	Good
Low		
M	2.93	3.15
SD	.50	.50
High		
M	2.73	3.17
SD	.49	.58

Note. Means are based upon 13 subjects within each condition. Several Freshman students (distributed equally across groups) had not yet received course grades during the Fall semester in which this study was run.

Discussion

The findings of this investigation shed light upon the nature of the cognitive deficits accompanying test anxiety, provide insights concerning the heterogeneity of test-anxious students, and suggest strategies for therapeutic intervention. Each of these three areas will subsequently be discussed in separate sections.

Test Anxiety and Information Processing

Current results demonstrate that test anxiety is associated with an impairment in information-processing capacity which is apparently independent of both ability and exam-taking skill. Although poor exam-taking skills are also found to contribute to such processing deficits, self-reported evaluation anxiety, by itself, seems to signal lowered cognitive effectiveness when task demands are high.

Test-anxious persons appear to have a deficit in their working memory or the ability to engage in effortful cognitive processing such as was required on both tasks of the present study. These decrements in ability do not emerge at the same time in all test-anxious subjects, however. Within the current dual-task paradigm, high test-anxious students with poor exam-taking skills displayed obvious and immediate performance declines on both primary and secondary tasks. Yet, such declines became most clearly evident only on the secondary task for test-anxious subjects with good exam-taking skills.

The latter finding is consistent with Eysenck's (1979) contention that anxious subjects frequently mobilize most of their attentional capacity in a compensatory manner on a task deemed primary, leaving little capacity to solve a concurrent secondary task. Moreover, it highlights the need to differentiate final outcomes from intervening processes (e.g., effort) in the study of test anxiety. Working memory deficits of skilled, test-anxious students are difficult to measure and may not be reflected directly in course grades or GPAs. Nevertheless, such deficits do exist in these individuals whose information-processing capabilities are adversely influenced by their heightened anxiety.

Contrary to expectations from an attentional-capacity model, however, deficits in secondary-task performance did not increase with accelerating primary-task difficulty. Examination of the pattern of total difference scores for each group provides grist for speculation concerning this finding (see Figure 2). Both groups high in exam-taking skills manifest essentially horizontal, linear functions across the five trial blocks. Thus, even high-anxious subjects continued to divide their attention in consistent, albeit unequal, fashion between the more difficult Raven matrices and the backward digits, whether completing these tasks separately or concurrently.

One possible explanation for the failure of test-anxious, exam-skilled persons to show increasing debilitation on later trials is the potential presence of a practice effect across the 20 trials. Performance gains resulting from greater familiarity and adeptness with the experimental tasks may have offset the effects of rising Raven item difficulty. This learning effect could partially account for their steady secondary-task performance in spite of progressively higher working memory demands.

Poorly skilled students, on the other hand, show virtually quadratic functions across the same trial blocks. This reflects a wide variability in attentional focus, wherein moment-to-moment fluctuations in concentration produced better digit retention on separate trials part of the time and on concurrent trials on the other part. Although a practice effect is also likely to exist within these subjects, learning seems to occur in a more haphazard manner. Following initial items, low-anxious students show a tendency toward facilitation of secondary task scoring in the concurrent condition, while high-anxious individuals experience greater disruption of performance under that presentation mode. Thus, lack of control over allocation of attentional capacity seems to especially hinder the cognitive performance of low-skilled students who are also test-anxious.

From the above, it may be inferred that exam skills assist attentional focusing, and possibly new-learning in the evaluative setting. Yet, this speculation merits some qualification. While high-anxious, skilled subjects did not manifest increasing decrements over trials in the number of digits remembered, relative to low-anxious, skilled peers, they did retain significantly fewer digits than the latter subjects. This suggests that mere possession of exam-taking strategies may not be sufficient to overcome working memory deficits brought on by worry during exam performance.

Indeed, questionnaire measures and post experimental verbal reports strongly implicate worry or internal attentional focus as a basic mechanism producing the above information-processing deficits. In this study, both poor exam skills and high test-anxiety generated cognitive interference during problem-solving activities. These intrusive thoughts include concerns about poor performance, ability level, embarassment in front of the experimenter, and receipt of failure feedback upon termination. Such thoughts have frequently been cited as characterizing the negative self-attention of test-anxious individuals (I. Sarason, 1975; Wine, 1971, 1980).

The fact that self-directed attention may arise in response to student awareness of low ability or deficient test-taking skills is consistent with positions taken by several authors (Benjamin et al., 1981; Culler & Holahan, 1980; Kirkland & Hollandsworth, 1980). Nevertheless, the negative self-focus of students possessing above-average skills clearly implies that factors other than ability and test-taking strategies are operational in some test-anxious students. As speculated earlier, the particular idiosyncratic meaning of evaluation for these persons and the accompanying negative self-efficacy expectations may form the basis for cognitive interference during mental-task performance.

The specific contribution of state anxiety (emotionality) to test anxiety deficits is less clear. Although both high test-anxious and poorly skilled individuals reported negative self-cognitions, only the former experienced heightened state anxiety. Thus, while unskilled, low test-anxious students were more preoccupied with their perceived deficient performance than skilled low test-anxious peers, they failed to develop the autonomic symptoms of the A-state reaction (Spielberger et al., 1970).

Conversely, low test-taking skill, coupled with high test anxiety seemed to be associated with increased levels of state anxiety. This is consistent with Deffenbacher's (1977) finding that emotionality appears to be most debilitating when it occurs within high levels of worry. Exam-skilled, but test-anxious students occuped a middle ground, experiencing only mild elevations in state anxiety. Good exam-taking ability may, therefore, be instrumental in moderating arousal prior to task performance.

One consideration in interpreting the state anxiety results must be the fact that the STAI-S was administered immediately following stress-inducing instructions, but prior to the experimental tasks. The STAI-S may thus be more correctly considered a measure of "anticipatory" state anxiety in the present study. It is possible that high-anxious, exam-skilled subjects would have shown increasing elevations on the STAI-S once testing was underway and they experienced some negative feedback. Indeed, several of these students were observed to become increasingly anxious overtly as the experiment progressed as evidenced by perspiration, seat position changes, nervous smiles and laughter. Unlike high-anxious, poorly skilled subjects who seemed "flooded" by their anxiety, such skilled, test-anxious students may have been able to exert cognitive and emotional control initially, but could not maintain this throughout testing.

In summary, both task results and subjects' self-report suggest that an attentional mechanism underlies test-anxiety information-processing deficits. Test-anxious individuals allocate attentional capacity toward task-irrelevant internal variables bringing about a decrease in available processing capacity for effortful cognitive tasks. Additionally, there are indications that augmented arousal may serve to either activate or accentuate processing deficits brought on by attentional misdirection. Students who obtained the lowest scores on the effortful primary and secondary tasks also reported the highest levels of both cognitive interference and emotional arousal. Therefore, these variables may synergistically combine in producing disruption of information processing.

How may the present results be integrated into a model of information processing in test-anxious individuals? Benjamin and his colleagues (1981), following from the work of Tobias (1979, 1980) and Mueller (1980), recently examined encoding and retrieval deficits in test anxiety. They proposed a linear formulation which posits that self-perception of one's low ability leads to achievement anxiety, which then results in poor study habits. In turn, less material is encoded in study, eventually leading to poor test performance. This is further aggravated by anxiety-induced retrieval difficulties from worry within the test situation. The authors point out that the above steps may actually be bidirectional interactions at any point in the process.

Such a sequence appears to accurately describe high test-anxious, poor exam-skilled subjects in this study. Their test anxiety seems to have generalized effects which may interfere with both encoding and retrieval of information. For these individuals, little control seems to exist over the allocation of attentional capacity in completing tasks requiring concerted mental effort (e.g., engagement in complex rehearsal strategies). Failure experiences lead to increased self-focusing of attention, additional failure, and consequent further self-attention. By the time that the unskilled test-anxious student reaches the examination, he or she is probably well involved in this self-defeating, immobilizing cycle or positive feedback loop.

With slight alterations, the same model may be used to describe skilled, test-anxious students. These individuals are high achievers with efficient study habits. Thus, they presumably encode material well early in study since their possession of effective strategies for study and exam-taking facilitates the controlled allocation of attention toward task-relevant cues. As the examination approaches, however, such persons may experience concentration difficulties in their final stages of study. During the actual examination, they may be unable to recall, organize, and express what they have learned. These processing deficits should be especially evident on test questions requiring novel or creative solutions.

As with low-skilled students, exam-skilled individuals evidence a decline in working memory capacity when compared to low test-anxious peers. The nature of the recalled material and task difficulty serve to determine when and how much of a processing decrement will occur at any specific time. Since their exam-taking skills aid attentional focusing during test taking, skilled students may not enter the above positive feedback loop until well into testing. However, the excessive effort which must be expended in countering internal cognitive distraction places a limit upon processing capability beyond which performance effectiveness rapidly falls off. Failure feedback, or even self-perceived failure, may then initiate a positively increasing cycle of worry and performance setbacks.

An advantage of the preceding formulation is that it views the poor test performance of test-anxious persons as the end product of a continuous process wherein ability, study and exam-taking skills, exam preparation, self-attention, emotional arousal, and expectancies all contribute in varying degrees to outcome. Approaches which isolate any single point of the sequence (e.g., study behavior) without reference to antecedent or consequent points may fail to appreciate the complexity of the test-anxious student's situation.

Test Anxiety Subtypes

The present study shows the existence of two subgroups of test-anxious individuals who differ in their knowledge of effective test-taking strategies and study habits. The first group is comprised of skilled test-anxious students who might best be characterized as "anxious performers". That is, they compensate well in most circumstances for their test anxiety through increased effort, yet show marked debilitation under conditions of overload which tax their compensatory mechanisms.

Within the university environment, such skilled, test-anxious students frequently overprepare for exams, budget their time well during exams, and adopt strategies which maximize classroom success. Culler and Holahan (1980) and Benjamin et al. (1981) report high numbers of study hours for high test-anxious students compared to low test-anxious peers. Thus, these students may expend relatively more effort to achieve the same ends.

As the present findings show, the academic records of such individuals may be quite good, tempting one to dismiss their heightened anxiety as inconsequential. Nevertheless, their reduced capacity for effortful problem solving may greatly hinder them when faced with new-learning or novel situations. This deficit in new learning ability may become evident on standardized tests (e.g., GRE) for which little preparation is possible and for which task cognitive demands are great. In other words, these students will likely be at a disadvantage whenever they are required to make problem-solving decisions without benefit of previous overlearning.

The second test-anxious subgroup is composed of high test-anxious students with poor exam-taking skills. In contrast to skilled, test-anxious individuals, these students not only experience heightened arousal and self-rumination during tests, but also possess few organizational strategies with which to negotiate the examination setting. Processing difficulties may become apparent in study and continue into the evaluative situation. The pervasiveness of these students' deficits has made them a highly visible segment of the population of test-anxious individuals. The prominent lack of adequate study- or exam-taking habits distinguishes this as a "skills-deficient" test-anxious subgroup. Results with the pretested sample suggest that, as Kirkland and Hollandsworth (1979, 1980) state, a majority of test-anxious students seems to fall within this category.

Treatment Implications

Benjamin et al. (1981) have suggested diagnosing the locus of information-processing deficits in test-anxious persons, particularly with respect to the presence or absence of effective study skills, prior to choosing intervention strategies. Present results support such diagnosis and imply the feasibility of utilizing standardized measures of test anxiety and exam-taking or study skills for this purpose. Potential treatment strategies for students in each of the two subclassifications identified in the current study will now be presented.

High test anxiety/good exam-taking skills. Despite adequate ability and knowledge of exam-taking, these students either fail to implement such strategies or have trouble maintaining a task-relevant focus due to heightened worry and/or arousal. Nevertheless, they perform adequately on tests much of the time, albeit at less-than-desired effectiveness, and may not seek assistance at university counseling centers.

Initial intervention within this subgroup should include evaluation of a student's total situation--reality of course or career goals, presence of performance pressures from family or friends, specific meaning of tests for the client, and attitudes and feelings toward personal failure. Such exploration might provide valuable insights into the nature and source of the client's self-defeating internal dialogue. For a small number of students, restructuring of occupational ambitions or re-evaluation of specific course goals (accepting a "B" in a difficult course) may reduce test anxiety and obviate the need for further treatment.

The majority of students in this subgroup, however, will require additional, specific assistance in dealing with the testing situation. Cognitive-behavioral techniques seem to be most consistently valuable here in altering client expectancies and fostering the development of self-enhancing thoughts. The primary goal at this stage of treatment should be the redirection of attention from internal variables toward task-relevant cues. For example, self-instructional statements may be provided to the student such as, "I know I can answer this question. I'll just relax a moment and think back to the class in which we discussed this topic." Anxiety-reduction therapies such as systematic desensitization and cue-controlled relaxation may also be used adjunctively to decrease discomfort and contribute to performance gains.

It is expected that information-processing capacity will increase with the above treatments in those high-stress situations which are the most debilitating for the exam-skilled, test-anxious student. Although some of these students may benefit from instruction in studying and test-taking, it is improbable that a majority of such persons need this training.

High test anxiety/poor exam-taking skills. These students' heightened evaluation anxiety arises from keen awareness of either ill-preparedness for exams or a paucity of exam-taking skills. Both encoding and retrieval deficits exist in such persons. Therefore, treatment which focuses solely upon improving the direction of attention in the exam setting may only partially alleviate their problems. These individuals require instruction in the mechanics of studying and exam-taking with the goals of more complete encoding of to-be-remembered material and more efficient retrieval of this information during exams. Provision of such strategies and consequent better preparation for exams should increase self-confidence, thereby reducing cognitive interference during test performance. Study-skills classes and workshops may frequently be enough to improve exam grades while lowering emotionality level. For other students, skills counseling may need to be augmented by one or more of the treatment techniques described in the previous section. As an example, a student may be instructed to tell himself or herself, "I have all the tools I need to get through this test. All I have to do is relax and focus upon what each question is asking."

The above processes may be facilitated through the development of local norms for test-anxiety and skills-assessment instruments within specific university or secondary environments.

Use of upper and lower cutoff scores would easily classify many clients for one of the above intervention strategies. For students not achieving distinct scores at either extreme, a more idiographic approach can be taken, with examination of the direction of scoring and use of more extensive interviewing to determine the initial focus of treatment.

Limitations of the Study

Several potential limitations to the current study may be cited. First, the relative preponderance of female versus male subjects precludes the making of any gender-specific conclusions concerning test anxiety, exam-taking skills, and information processing. The decreased availability of male subjects may partially reflect the growing female majority within the university population targeted for this study.

It is unlikely, however, that men fail to experience anxiety in the testing situation. Rather, it is probable that social learning may cause many males to publicly attribute diminished exam performance to variables such as boredom, task difficulty, lack of effort, or other external influences. This false bravado may prevent many college males from self-identifying as test-anxious. Thus, they may not seek assistance at university counseling centers or affirmatively endorse items on preselection instruments in test-anxiety studies. Future research might examine these possibilities.

The analogue nature of this study may be offered as a second limitation. Subjects were not actual counseling-center clients and experimental tasks bore little resemblance to tests encountered in the typical classroom setting.

Notwithstanding the fact that the vast majority of studies in the test-anxiety literature have employed analogue designs (Galassi et al., 1981), the above criticism assumes lesser import when the primary goal of this experiment is examined. The present study attempted to measure information-processing deficits in test-anxious persons utilizing two moderately difficult tasks. In particular, the backward Digit Span task is believed to sensitively measure fluctuations in short-term memory and attentional capacity (Hayslip & Kennelly, in press; Kennelly et al., 1980). As such, it is intended to measure processes assumed to be important in effortful problem solving.

With this ambition in mind, several factors preclude the use of the classroom setting for such an investigation. Classroom tests frequently measure longterm retention of course material, therefore focusing upon content rather than underlying processes per se. Since little control exists for differential student preparation (rehearsal encoding of material), studies employing classroom examinations as dependent variables cannot easily separate actual knowledge of subject matter from difficulties in the retrieval and active processing of such material in the exam itself. The novelty of both of the present experimental tasks insured that prior learning would have little effect upon subject performance.

The typical classroom additionally does not allow for the experimental control necessary in manipulating as variable a commodity as attention. Person x environment interactions may be present and highly idiosyncratic across individuals. As an example, Sarason (1981) has recently shown strong social influences upon levels of test anxiety experienced in specific situations. While the myriad of environmental factors affecting test-anxious students is a legitimate topic of inquiry in its own right, such was not a subject of interest in the current study.

Although essentially a laboratory investigation, it is believed that the present research possesses external validity for the classroom setting. The emergence of information-processing deficits during an analogue procedure suggests that even-greater disruptions may be expected in actual classroom tests which are meaningfully related to student course and career goals. This inference is strengthened by the fact that, in the debriefing interview, many students spontaneously draw parallels between processing difficulties during the experiment and those encountered in real-life tests. Problems in concentrating, organizing one's thoughts, and with one's mind "going blank" were frequently mentioned.

The possible confounding influence of intellectual ability upon present cognitive-task results may be offered as another limitation of this study. It might be argued that low test-anxious students are more intelligent than their high test-anxious counterparts, while students with a large repertoire of exam-taking behaviors exceed those with more limited resources. Continuing this line of reasoning, the fact that the Raven test if often considered a nonverbal measure of intelligence suggests that intellectual ability, rather than test anxiety or exam skills, may account for intergroup differences in this study.

This potential criticism merits further examination. That exam-taking skills and intellectual ability are not necessarily related is shown by the virtually identical performance of low test-anxious subjects with good and poor exam-taking skills on the Raven task. Similarly, the comparable Raven scores obtained by high and low test-anxious students with good exam skills suggest that test anxiety is not directly associated with intelligence.

If ability, as measured by the Raven, is assumed to account for the variance in secondary-task performance, it would also be expected that the three groups with equivalent scores on the Raven task should perform equally on the Digit Span task. This is not the case. High test-anxious students with good exam-taking skills retained significantly fewer digits than skilled low test-anxious students, though both groups attained Raven scores that did not significantly differ.

The preceding analysis suggests that the present pattern of results are inconsistent with a pure ability explanation of processing deficits in the present study. Any interpretation of these findings which invokes the construct of ability must, in fact, define what is meant by ability. Within an information-processing model, ability can be a label applied to the results of the application of a set of mental operations to a problem requiring effort in its solution. From this viewpoint, any attempts to covary out the effects of ability from a cognitive task (e.g., SAT scores, GPA, WAIS IQ) are futile since all such covariates are end products of many of the very processes we seek to measure.

Fortunately, in practical terms, the actual situation need not be as bleak as the above implies. Ultimately, ability, as measured on standardized aptitude tests, is irrelevant in the treatment of most test-anxious college students. What is relevant is the fact that procedures which lessen anxiety and increase attentional focusing of such students can improve information processing within the examination setting. As has been demonstrated, exam-taking instruction and cognitive-behavioral therapies can be potent instruments for such focusing.

Conclusions

It seems appropriate at this time to examine this study's findings in the light of previously enumerated goals. First, this endeavor successfully identifies two subgroups of test-anxious students with opposite levels of exam-taking ability. This confirms that test anxiety cannot be considered merely a skills deficit as has been claimed (Culler & Holahan, 1980; Kirkland & Hollandsworth, 1979, 1980). By extension, it also implies that skills-training alone may not adequately lower test anxiety or improve exam achievement in all test-anxious students.

Second, this study clearly shows that the above subgroups are meaningfully related to information-processing ability within the evaluative context. Specifically, high test-anxious students with above-average exam skills expend greater effort in problem solving to overcome internally generated cognitive interference. This effort produces performances comparable to those of low-anxious peers up to the point where task demands exceed their diminished attentional capacity. High-anxious, low-skills students, on the other hand, manifest an immediate deficit in problem solving.

The third goal of this research was to examine the test-taking cognitions of test-anxious students. Consistent with the reports of Wine (1971, 1980) and numerous other authors, such students experience frequent intrusions of unwanted self-defeating thoughts during problem solving. The fact that students low in exam skills also engage in negative self-focusing suggests the importance of exam-taking strategies to task-relevant processing and self-confidence during exams.

Future research needs to further expand and clarify our understanding of factors influencing information processing of students within the two groups above. One avenue might be the discovery of which rehearsal strategies work best for which students, employing designs resembling those of Mueller (1980). Another goal might be the greater specification of the construct of working memory into component parts, as has recently been suggested by Baddeley (1981). More precise instrumentation to assess information-processing variables is additionally needed. Finally, treatment programs which are based upon the classification of test-anxious students by exam-taking skill level must be implemented and the results evaluated. Only with such empirical verification will the present findings acquire clinical relevance.

The current study represents one of the few attempts to look at the cognitive performance of high and low test-anxious individuals as a function of exam-taking ability. It is hoped that it will serve as a stimulus for others to pursue answers to the many questions it raises. At present, it is sufficient to state that these findings demonstrate the continuing usefulness of the "test anxiety" construct from both theoretical and applied perspectives.

Appendix A

Subject Information Form

Test-Taking Study

We are currently engaged in a study looking at how people react to college tests such as midterm and final exams. Enclosed are three short questionnaires which measure your thoughts and feelings about taking tests. Note that, for the questionnaire which is in booklet form (Effective Study Test), you only need to answer the circled items using the last column of the answer sheet. Be sure to also fill in the section below which will provide us with some background information about people participating in this study. Your answers to these questions and to all of the other questionnaires are completely confidential and will not be shared with your instructor or any other student. (Your name will be dropped and replaced by a number for data analysis.)

Because this study is divided into two sections, a few of you will be contacted and asked to come in for about a half hour to do a couple of more tasks. The success of this study depends upon a certain number of you completing both sections. Therefore, if contacted, please try to find a convenient time in your schedule when you can come back in for a short while.

When you've finished filling in these forms, please place them all back in the booklet and turn them in.

Thanks a lot for your help.

Ron Paulman

Background Information Sheet

______________________ Name

______________________ Phone Number

______________________ Year in School

______________________ Major

______________________ Course

_________________ Cumulative GPA (Again, this is completely confidential. Please try to report your GPA as closely as you can.)

Appendix B

Instructions, Items and Scoring Key for the Test Anxiety Scale

This is a questionnaire designed to measure some of your thoughts and feelings about taking tests. Please be assured that all of your answers are strictly confidential and that a number will later be assigned in place of your name. Just circle either the "T" (True) or "F" (False) responses as they apply to you. Thank you for your help.

(Keyed answers are in parentheses)

1. While taking an important exam, I find myself thinking of how much brighter the other students are than I am. (T)
2. If I were to take an intelligence test, I would worry a great deal before taking it. (T)
3. If I knew I was going to take an intelligence test, I would feel confident and relaxed, beforehand. (F)
4. While taking an important examination, I perspire a great deal. (T)
5. During course examinations, I find myself thinking of things unrelated to the actual course material. (T)
6. I get to feel very panicky when I have to take a surprise exam. (T)
7. During tests, I find myself thinking of the consequences of failing. (T)
8. After important tests, I am frequently so tense that my stomach gets upset. (T)
9. I freeze up on things like intelligence tests and final exams. (T)
10. Getting a good grade on one test doesn't seem to increase my confidence on the second. (T)
11. I sometimes feel my heart beating very fast during important exams. (T)
12. After taking a test, I always feel I could have done better than I actually did. (T)

13. I usually get depressed after taking a test. (T)

14. I have an uneasy, upset feeling before taking a final examination. (T)

15. When taking a test, my emotional feelings do not interfere with my performance. (F)

16. During a course examination, I frequently get so nervous that I forget facts I really know. (T)

17. I seem to defeat myself while working on important tests. (T)

18. The harder I work at taking a test or studying for one, the more confused I get. (T)

19. As soon as an exam is over, I try to stop worrying about it, but I just can't. (T)

20. During exams, I sometimes wonder if I'll ever get through college. (T)

21. I would rather write a paper than take an examination for my grade in a course. (T)

22. I wish examinations did not bother me so much. (T)

23. I think I could do much better on tests if I could take them alone and not feel pressured by a time limit. (T)

24. Thinking about the grade I may get in a course interferes with my studying and my performance on tests. (T)

25. If examinations could be done away with, I think I would actually learn more. (T)

26. On exams, I take the attitude, "If I don't know it now, there's no point worrying about it." (F)

27. I really don't see why some people get so upset about tests. (F)

28. Thoughts of doing poorly interfere with my performance on tests. (T)

29. I don't study any harder for final exams than for the rest of my course work. (F)

30. Even when I'm well prepared for a test, I feel very anxious about it. (T)

31. I don't enjoy eating before an important test. (T)

32. Before an important examination, I find my hands or arms trembling. (T)

33. I seldom feel the need for "cramming" before an exam. (F)

34. The university should recognize that some students are more nervous than others about tests and that this affects their performance. (T)

35. It seems to me that examination periods should not be made such tense situations. (T)

36. I start feeling very uneasy just before getting a test paper back. (T)

37. I dread courses where the professor has the habit of giving "pop" quizzes. (T)

Appendix C

Scoring Procedures for Digit Span Task

General Rule

The digit span score on any single trial equals 6 minus the minimum number of moves (as defined below) required to restore the subject's response to the correctly reversed sequence.

Definition of Move

Each of the following situations constitutes one move to be subtracted from the maximum Digit Span score of 6.

1. Addition of an omitted number to the digit series.

   Example: 201385 Correct Response

   20 385 Subject Response

   Score: 6 - 1 = 5

2. Removal of a confabulated or extraneous number from the digit series.

   Example: 201385 Correct Response

   2013857 Subject Response

   Score: 6 - 1 = 5

3. Relocation of an incorrectly placed number to another position.

   Example: 201385 Correct Response

   201358 Subject Response

   Score: 6 - 1 = 5

   Example: 201385 Correct Response

   501382 Subject Response

   Score: 6 - 2 = 4

Appendix D

Cognitive Interference Questionnaire

I am interested in learning about the kinds of thoughts that go through people's heads while they are working on tasks such as the ones which you just completed. The following list includes some thoughts you might have had while doing the tasks that you've just completed. Please indicate approximately how often each thought occurred to you while working on these tasks by placing the appropriate number in the blank provided to the left of each question.

(Adapted from I. Sarason, 1980, p. 10)

Example: 1 = never; 2 = once; 3 = a few times; 4 = often; 5 = very often

_____ 1. I thought about how poorly I was doing.

_____ 2. I wondered what the experimenter would think of me.

_____ 3. I thought about how I should work more carefully.

_____ 4. I thought about how much time I should spend on the tasks.

_____ 5. I thought about how others might have done on these tasks.

_____ 6. I thought about the difficulty of the tasks.

_____ 7. I thought about my level of ability.

_____ 8. I thought about the purpose of the experiment.

_____ 9. I thought about how I would feel if I were told how I performed.

_____10. I thought about how often I got confused.

_____11. I thought about things completely unrelated to the experiment.

Appendix E

Debriefing Instrument

1. Please rate how difficult the two tasks (design problems and numbers) were when compared to one another.

1	2	3	4	5	6	7
Designs more Difficult			About the Same Difficulty			Numbers more Difficult

2. How well do you think you did on the design problems compared to other people in this study?

1	2	3	4	5	6	7
Below Average			Average			Above Average

3. How well do you think you did in remembering the numbers compared to other people in this study?

1	2	3	4	5	6	7
Below Average			Average			Above Average

4. How often did you use a strategy of some kind (i.e., repeating the numbers in your head) to remember the numbers while working on the problems?

1	2	3	4	5	6	7
Hardley Ever			About Half of the Time			Most of the Time

5. Compared to the times when you repeated the numbers back immediately, how difficult was it to wait until after you finished the design problem to repeat the numbers?

1	2	3	4	5	6	7
Easier			About the Same			Much More Difficult

6. Please rate how nervous you were when doing the two tasks (design problems and numbers) you just completed?

1	2	3	4	5	6	7
Very Little			Moderately Nervous			Quite a Lot

Appendix F

Table 8

Summary of ANOVA on Raven Scores for Test Anxiety, Exam Skills, and Experimenter Factors

Source	Degrees of Freedom	Mean Square	F
Test Anxiety (A)	1	107.77	9.09**
Exam Skills (B)	1	28.98	2.44
Experimenter (C)	1	1.52	< 1
A x B	1	53.28	4.49*
A x C	1	16.39	1.38
B x C	1	.06	< 1
A x B x C	1	11.90	1.00
Error	56	11.86	

*$p < .05$

**$p < .005$

Appendix G

Table 9

Summary of ANOVA on Separate-Mode Digit Span Scores for Test Anxiety, Exam Skills, and Experimenter Factors

Source	Degrees of Freedom	Mean Square	F
Test Anxiety (A)	1	148.01	5.75*
Exam Skills (B)	1	143.33	5.57*
Experimenter (C)	1	0.00	< 1
A x B	1	.70	< 1
A x C	1	15.77	< 1
B x C	1	22.40	< 1
A x B x C	1	.13	< 1
Error	56	25.77	

$p < .05$

Appendix H

Table 10

Summary of ANOVA on Concurrent-Mode Digit Span Scores for Test Anxiety, Exam Skills, and Experimenter Factors

Source	Degrees of Freedom	Mean Square	F
Test Anxiety (A)	1	342.85	5.37*
Exam Skills (B)	1	86.88	1.36
Experimenter (C)	1	5.19	< 1
A x B	1	1.45	< 1
A x C	1	1.85	< 1
B x C	1	3.08	< 1
A x B x C	1	8.04	< 1
Error	56	63.95	

*$p < .05$

Appendix I

Table 11

Summary of ANOVA on CIQ Scores for Test Anxiety, Exam Skills, and Experimenter Factors

Source	Degrees of Freedom	Mean Square	F
Test Anxiety (A)	1	647.92	14.99**
Exam Skills (B)	1	223.25	5.17*
Experimenter (C)	1	.19	< 1
A x B	1	48.60	1.12
A x C	1	27.34	< 1
B x C	1	.76	< 1
A x B x C	1	177.31	4.10*
Error	56	43.21	

*$p < .05$

**$p < .001$

Appendix J

Table 12

Summary of ANOVA on STAI-S Scores for Test Anxiety, Exam Skills, and Experimenter Factors

Source	Degrees of Freedom	Mean Square	F
Test Anxiety (A)	1	481.81	6.86*
Exam Skills (B)	1	23.92	< 1
Experimenter (C)	1	2.02	< 1
A x B	1	25.69	< 1
A x C	1	10.25	< 1
B x C	1	8.23	< 1
A x B x C	1	1.33	< 1
Error	56	70.21	

*$p < .05$

Appendix K

Table 13

Summary of MANOVA on Raven, Separate Digit-Span, Concurrent Digit-Span, CIQ, and STAI-S Scores for Test Anxiety and Exam Skills Factors

Source	Degrees of Freedom	Wilks' Lambda	F
Test Anxiety (A)	5	.64435	6.18**
Exam Skills (B)	5	.79354	2.91*
A x B	5	.91501	1.04
Error	56		

*$p < .025$

**$p < .001$

Appendix L

Table 14

Summary of ANOVA on Raven Scores for Test Anxiety and Exam Skills Factors

Source	Degrees of Freedom	Mean Square	F
Test Anxiety (A)	1	60.14	5.56*
Exam Skills (B)	1	17.00	1.57
A x B	1	17.14	1.58
Error	60	10.81	

*$p < .05$

Appendix M

Table 15

Summary of ANOVA on Raven Scores for Test Anxiety, Exam Skills, and Presentation Mode Factors

Source	Degrees of Freedom	Mean Square	F
Test Anxiety (A)	1	46.32	8.36*
Exam Skills (B)	1	18.75	3.38
A x B	1	20.33	3.67
Error Between	60	5.54	
Presentation Mode (C)	1	2.25	1.72
A x C	1	.39	< 1
B x C	1	2.27	1.73
A x B x C	1	4.12	3.14
Error Within	60	1.31	

*$p < .01$

Appendix N

Table 16

Summary of ANOVA on Digit Span Scores for Test Anxiety, Exam Skills, and Presentation Mode Factors

Source	Degrees of Freedom	Mean Square	F
Test Anxiety (A)	1	616.89	10.10**
Exam Skills (B)	1	334.76	5.48*
A x B	1	.38	< 1
Error Between	60	61.08	
Presentation Mode (C)	1	46.32	1.95
A x C	1	67.64	2.84
B x C	1	15.00	< 1
A x B x C	1	14.00	< 1
Error Within	60	23.80	

*$p < .05$

**$p < .005$

Appendix O

Table 17

Summary of ANOVA on Digit Span Difference Scores for Test Anxiety, Exam Skills, and Trial Block Factors

Source	Degrees of Freedom	Mean Square	F
Test Anxiety (A)	1	20.00	2.52
Exam Skills (B)	1	7.80	< 1
A x B	60	.30	< 1
Error Between		7.95	
Trial Block (C)	4	1.35	< 1
A x C	4	3.60	1.09
B x C	4	3.14	< 1
A x B x C	4	5.21	1.58
Error Within	240	3.30	

Note. $p > .05$ for all F values.

Appendix P

Table 18

Summary of ANOVA on CIQ Scores for Test Anxiety and Exam Skills Factors

Source	Degrees of Freedom	Mean Square	F
Test Anxiety (A)	1	534.77	12.32**
Exam Skills (B)	1	284.77	6.56*
A x B	1	1.26	< 1
Error	60	43.39	

*$p < .05$

**$p < .001$

Appendix Q

Table 19

Summary of ANOVA on STAI-S Scores for Test Anxiety and Exam Skills Factors

Source	Degrees of Freedom	Mean Square	F
Test Anxiety (A)	1	606.39	9.20*
Exam Skills (B)	1	28.99	< 1
A x B	1	47.26	< 1
Error	60	65.88	

*$p < .005$

Appendix R

Table 20

Summary of ANOVA on Item 1 Scores of Debriefing Questionnaire for Test Anxiety and Exam Skills Factors

Source	Degrees of Freedom	Mean Square	F
Test Anxiety (A)	1	5.64	2.34
Exam Skills (B)	1	1.27	< 1
A x B	1	33.39	13.85*
Error	60	2.41	

*$p < .001$

Appendix S

Table 21

Summary of ANOVA on Item 2 Scores of Debriefing Questionnaire for Test Anxiety and Exam Skills Factors

Source	Degrees of Freedom	Mean Square	F
Test Anxiety (A)	1	2.34	2.96
Exam Skills (B)	1	2.64	3.34
A x B	1	.39	< 1
Error	60	.79	

Note. $p > .05$ for all F values.

Appendix T

Table 22

Summary of ANOVA on Item 3 Scores of Debriefing Questionnaire for Test Anxiety and Exam Skills Factors

Source	Degrees of Freedom	Mean Square	F
Test Anxiety (A)	1	11.39	8.97*
Exam Skills (B)	1	.77	< 1
A x B	1	.01	< 1
Error	60	1.27	

*$p < .01$

Appendix U

Table 23

Summary of ANOVA on Item 4 Scores of Debriefing Questionnaire for Test Anxiety and Exam Skills Factors

Source	Degrees of Freedom	Mean Square	F
Test Anxiety (A)	1	1.27	< 1
Exam Skills (B)	1	.39	< 1
A x B	1	.01	< 1
Error	60	1.62	

Note. $p > .05$ for all F values.

Appendix V

Table 24

Summary of ANOVA on Item 5 Scores of Debriefing Questionnaire for Test Anxiety and Exam Skills Factors

Source	Degrees of Freedom	Mean Square	F
Test Anxiety (A)	1	5.65	2.16
Exam Skills (B)	1	1.90	< 1
A x B	1	1.25	< 1
Error	60	2.62	

Note. $p > .05$ for all F values.

Appendix W

Table 25

Summary of ANOVA on Item 6 Scores of Debriefing Questionnaire for Test Anxiety and Exam Skills Factors

Source	Degrees of Freedom	Mean Square	F
Test Anxiety (A)	1	49.00	26.92**
Exam Skills (B)	1	1.00	< 1
A x B	1	9.00	4.94*
Error	60	1.82	

*$p < .05$

**$p < .001$

Appendix X

Table 26

Summary of ANOVA on GPA Scores for Test Anxiety and Exam Skills Factors

Source	Degrees of Freedom	Mean Square	F
Test Anxiety (A)	1	.22	< 1
Exam Skills (B)	1	2.22	6.93*
A x B	1	.10	< 1
Error	48	.32	

*$p < .05$

References

Abramson, L. Y., Seligman, M. E., & Teasdale, J. P. Learned helplessness in humans: Critique and reformulation. Journal of Abnormal Psychology, 1978, 87, 49-74.

Allen, G. J. Effectiveness of study counseling and desensitization in alleviating test anxiety in college students. Journal of Abnormal Psychology, 1971, 77, 282-289.

Allen, G. J., Elias, M. J., & Zlotlow, S. F. Behavioral interventions for alleviating test anxiety: A methodological overview of current therapeutic practices. In I. G. (Sarason (Ed.), Test Anxiety: Theory, research, and applications. Hillsdale, N.J.: Erlbaum, 1980.

Alpert, R., & Haber, R. Anxiety in academic achievement situations. Journal of Abnormal and Social Psychology, 1960, 61, 207-215.

Anton, W. D. An evaluation of outcome variables in the systematic desensitization of test anxiety. Behavior Research and Therapy, 1976, 14, 217-224.

Baddeley, A. The concept of working memory: A view of its current state and probable future development. Cognition, 1981, 10, 17-23.

Baddeley, A. D., & Hitch, G. J. Working memory. In G. A. Bower (Ed.), The psychology of learning and motivation (Vol. 8). New York: Academic Press, 1974.

Bandura, A. Self-efficacy: Toward a unifying theory of behavioral change. Psychological Review, 1977, 84, 191-215.

Benjamin, M., McKeachie, W. J., Lin, Y. G., & Holinger, D. P. Test anxiety: Deficits in information processing. Journal of Educational Psychology, 1981, 73, 816-824.

Broadbent, D. E. Perception and communication. London: Pergamon Press, 1958.

Broadbent, D. E. Decision and stress. London: Academic Press, 1971.

Brown, W. F. Effective Study Test: Manual of directions. San Marcos, Tex.: Effective Study Materials, 1975.

Bruch, M. A. Relationship of test-taking strategies to test anxiety and performance: Toward a task analysis of examination behavior. Cognitive Therapy and Research, 1981, 5, 41-56.

Carver, C. S. A cybernetic model of self-attention processes. Journal of Personality and Social Psychology, 1979, 37, 1251-1281.

Carver, S., & Blaney, P. H. Perceived arousal, focus of attention, and avoidance behavior. Journal of Abnormal Psychology, 1977, 86, 154-162.

Cornish, R. D., & Dilley, J. S. Comparison of three methods of reducing test anxiety: Systematic desensitization, implosive therapy, and study counseling. Journal of Counseling Psychology, 1973, 20, 499-503.

Craik, F. I. M., & Lockhart, R. S. Levels of processing; A framework for memory research. Journal of Verbal Learning and Verbal Behavior, 1972, 11, 671-684.

Coyne, J. C., Metalsky, G. I., & Lavelle, T. L. Learned helplessness as experimenter induced failure and its alleviation with attentional redeployment. Journal of Abnormal Psychology, 1980, 89, 350-358.

Culler, R. E., & Holahan, C. J. Test anxiety and academic performance: The effects of study-related behavior. Journal of Educational Psychology, 1980, 72, 16-20.

D'Alelio, W. A., & Murray, E. J. Cognitive therapy for test anxiety. Cognitive Therapy and Research, 1981, 5, 299-307.

Deffenbacher, J. L. Relationship of worry and emotionality to performance on the Miller Analogies Test. Journal of Educational Psychology, 1977, 69, 191-195.

Deffenbacher, J. L. Worry, emotionality and task-generated interference in test-anxiety: An empirical test of attentional theory. Journal of Educational Psychology, 1978, 70, 248-254.

Deffenbacher, J. L. Worry and emotionality in test anxiety. In I. G. Sarason (Ed.), Test anxiety: Theory, research, and applications. Hillsdale, N.J.: Erlbaum, 1980.

Deffenbacher, J. L., & Snyder, A. L. Relaxation as self-control in the treatment of test and other anxieties. Psychological Reports, 1976, 39, 379-385.

Denney, D. Active, passive, and vicarious desensitization. Journal of Counseling Psychology, 1974, 21, 369-375.

Denney, D. R. Self-control approaches to the treatment of test anxiety. In I. G. Sarason (Ed.), Test anxiety: Theory, research, and applications. Hillsdale, N.J.: Erlbaum, 1980.

Desiderato, O., & Koskinen, P. Anxiety, study habits, and academic underachievement. Journal of Counseling Psychology. 1969, 16, 162-165.

Deutsch, J. A., & Deutsch, D. Attention: Some theoretical considerations. Psychological Review, 1963, 70, 80-90.

Dey, M. K. Anagram solution speed as a joint function of manifest anxiety and number of category sets. American Journal of Psychology, 1978, 91, 81-88.

Di Tomasso, R. A. A meta-analysis of therapy outcome research with test-anxious college students (Doctoral dissertation, University of Pennsylvania, 1980). Dissertation Abstracts International, 1981, 41, 3884B. (University Microfilms No. 8107732)

Doctor, R. M., & Altman, F. Worry and emotionality as components of test anxiety: Replication and further data. Psychological Reports, 1969, 24, 563-568.

Doris, J., & Sarason, S. B. Test anxiety and blame assignment in a failure situation. Journal of Abnormal and Social Psychology, 1955, 50, 335-338.

Dusek, J. B., Kermis, M. D., & Mergler, N. L. Information processing in low- and high-test-anxious children as a function of grade level and verbal labeling. Developmental Psychology, 1975, 11, 651-652.

Dusek, J. B., Mergler, N. L., & Kermis, M. D. Attention, encoding, and information processing in low- and high-test-anxious children. Child Development, 1976, 47, 201-207.

Duval, S., & Wicklund, R. A. A theory of objective self awareness. New York: Academic Press, 1972.

Easterbrook, J. A. The effect of emotion on cue-utilization and the organization of behavior. Psychological Review, 1959, 66, 183-201.

Eysenck, M. W. Human memory: Theory, research, and individual differences. Oxford: Pergamon Press, 1977.

Eysenck, M. W. Anxiety, learning, and memory: A reconceptualization. Journal of Research in Personality, 1979, 13, 363-385.

Finger, R., & Galassi, J. P. Effects of modifying cognitive versus emotionality responses in the treatment of test anxiety. Journal of Counsulting and Clinical Psychology, 1977, 45, 280-287.

Galassi, J. P., Frierson, H. T., Jr., & Sharer, R. Behavior of high, moderate, and low test anxious students during an actual test situation. Journal of Consulting and Clinical Psychology, 1981, 49, 51-62.

Geen, R. G. Test anxiety, observation, and range of cue utilization. British Journal of Social and Clinical Psychology, 1976, 15, 253-259.

Geen, R. G. Test anxiety and cue utilization. In I. G. Sarason (Ed.), Test anxiety: Theory, research, and applications. Hillsdale, N.J.: Erlbaum, 1980.

Goldfried, M. R. Systematic desensitization as training in self-control. Journal of Consulting and Clinical Psychology, 1971, 37, 228-234.

Goldfried, M. R. The use of relaxation and cognitive relabeling as coping skills. In R. B. Stuart (Ed.), Behavioral self management: Strategies, techniques, and outcomes. New York: Bruener-Mazel, 1977.

Goldfried, M. R., Linehan, M. M., & Smith, J. L. Reduction of test anxiety through cognitive restructuring. Journal of Consulting and Clinical Psychology, 1978, 48, 32-39.

Gross, R. F., & Mastenbrook, M. Examination of the effects of state anxiety on problem-solving efficiency under high and low memory conditions. Journal of Educational Psychology, 1980, 72, 605-609.

Hamilton, V. Socialization anxiety and information processing: A capacity model of anxiety-induced performance deficits. In I. G. Sarason & C. D. Spielberger (Eds.), Stress and anxiety (Vol. 2). Washington, D. C.: Hemisphere Publishing, 1975.

Hasher, L., & Zacks, R. T. Automatic and effortful processes in memory. Journal of Experimental Psychology: General, 1979, 108, 336-388.

Hayslip, B., Jr., & Kennelly, K. J. Short-term memory and crystallized-fluid intelligence in adulthood. Research on Aging, 1982, in press.

Heinrich, D. L. The causal influence of anxiety on academic achievement for students of differing intellectual ability. Applied Psychological Measurement, 1979, 3, 351-359.

Hollandsworth, J. G., Glazeski, R. C., Kirkland, K., Jones, G., & Van Norman, L. R. An analysis of the nature and effects of test anxiety: Cognitive, behavioral, and physiological components. Cognitive Therapy and Research, 1979, 3, 165-180.

Holroyd, K .A. Cognition and desensitization in the group treatment of test anxiety. Journal of Consulting and Clinical Psychology, 1976, 44, 991-1001.

Holroyd, K. A., & Appel, M. A. Test anxiety and physiological responding. In I. G. Sarason (Ed.), Test anxiety: Theory, research, and applications. Hillsdale, N.J.: Erlbaum, 1980.

Holroyd, K. A., Westbrook, T., Wolf, M., & Badhorn, E. Performance, cognition and physiological responding in test anxiety. Journal of Abnormal Psychology, 1978, 87, 442-451.

Horn, J. L., & Cattell, R. B. Refinement and test of the theory of fluid and crystallized intelligence. Journal of Educational Psychology, 1966, 57, 253-270.

Horne, A. M., & Matson, J. L. A comparison of modeling, desensitization, flooding, study skills and control groups for reducing test anxiety. Behavior Therapy, 1977, 8, 1-8.

Hunt, E. Intelligence as an information-processing concept. British Journal of Psychology, 1980, 71, 449-474.

Kahneman, D. Attention and effort. New Jersey: Prentice-Hall, 1973.

Kaplan, R. M. McCordick, S. M., & Twitchell, M. Is it the cognitive or the behavioral component which makes cognitive-behavior modification effective in test anxiety? Journal of Counseling Psychology, 1979, 26, 331-377.

Kennelly, K. J., Crawford, D., Waid, L. W., & Rahaim, S. Partial reinforcement immunizes against helplessness induced short-term memory deficits. Catalog of Selected Documents in Psychology, 1980, 10, August 59 (MS. 2091).

Kerr, B. Processing demands during mental operations. Memory and Cognition, 1973, 1, 401-412.

Kiesler, D. J. Some myths of psychotherapy research and the search for a paradigm. Psychological Bulletin, 1966, 65, 110-136.

Kirkland, K., & Hollandsworth, J. G. Test anxiety, study skills, and academic performance. Journal of College Student Personnel, 1979, 20, 431-436.

Kirkland, K., & Hollandsworth, J. G. Effective test taking: Skills-acquisition versus anxiety-reduction techniques. Journal of Consulting and Clinical Psychology, 1980, 48, 431-439.

Lavelle, T. L., Metalsky, G. I., & Coyne, J. C. Learned helplessness, test anxiety, and acknowledgement of contingencies. Journal of Abnormal Psychology, 1979, 88, 381-387.

Leal, L. L., Baxter, E. G., Martin, J., & Marx, R. W. Cognitive modification and systematic desensitization with test anxious high school students. Journal of Counseling Psychology, 1981, 28, 525-528.

Liebert, R. M., & Morris, L. W. Cognitive and emotional components of test anxiety: A distinction and some initial data. Psychological Reports, 1967, 20, 975-978.

Logan, G. D. Attention in character-classification tasks: Evidence for the automaticity of component states. Journal of Experimental Psychology: General, 1978, 107, 32-63.

Lopez, R. G. Test anxiety: Toward a multidimensional treatment. Unpublished manuscript, University of Minnesota, 1976.

Mandler, G., & Sarason, S. B. A study of anxiety and learning. Journal of Abnormal Psychology, 1952, 47, 166-173.

McCordick, S. M., Kaplan, R. M., Smith, S., & Finn, M. E. Variations in cognitive behavior modification for test anxiety. Psychotherapy, Theory, Research and Practice, 1981, 18, 170-178.

Meichenbaum, D. Cognitive modification of test anxious college students. Journal of Consulting and Clinical Psychology, 1972, 39, 370-380.

Meichenbaum, D. H. Cognitive-behavior modification. New York: Plenum Press, 1977.

Meichenbaum, D., & Butler, L. Toward a conceptual model for the treatment of test anxiety: Implications for research and treatment. In I. G. Sarason (Ed.), Test anxiety: Theory, research, and applications. Hillsdale, N.J.: Erlbaum, 1980.

Michaud, J. T. Test anxiety and cognitive processes (Doctoral dissertation, University of Missouri-Columbia, 1979). Dissertation Abstracts International, 1980, 40, 4495B. (University Microfilms No. 8007176)

Mitchell, K., & Ng, K. Effects of group counseling and behavior therapy on the academic achievement of test anxious students. Journal of Counseling Psychology, 1972, 19, 491-497.

Montgomery, G. K. Effects of performance evaluations and anxiety on cardiac response in anticipation of difficult problem solving. Psychophysiology, 1977, 14, 251-253.

Morris, L. W., & Fulmer, R. S. Test anxiety (worry and emotionality) changes during academic testing as a function of feedback and test importance. Journal of Educational Psychology, 1976, 68, 817-824.

Morris, L. W., & Liebert, R. M. Relationship of cognitive and emotional components of test anxiety to physiological arousal and academic performance. Journal of Consulting and Clinical Psychology, 1970, 35, 332-333.

Morris, L. W., Davis, M. A., & Hutchings, C. H. Cognitive and emotional components of anxiety: Literature review and a revised worry-emotionality scale. Journal of Educational Psychology, 1981, 73, 541-555.

Mueller, J. H. Anxiety and cue utilization in human learning and memory. In M. Zuckerman and C. D. Spielberger (Eds.), Emotion and anxiety: New concepts, methods and applications. Hillsdale, N.J.: Erlbaum, 1976.

Mueller, J. H. The effects of individual differences in test anxiety and type of orienting task on levels of organization in free recall. Journal of Research in Personality, 1978, 12, 100-116.

Mueller, J. H. Test anxiety and the encoding and retrieval of information. In I. G. Sarason (Ed.), Test anxiety: Theory, research, and applications. Hillsdale, N.J.: Erlbaum, 1980.

Mueller, J. H., Carlomusto, M., & Marler, M. Recall as a function of method of presentation and individual differences in test anxiety. Bulletin of the Psychonomic Society, 1977, 10, 447-450.

Mueller, J. H., Carlomusto, M., & Marler, M. Recall and organization in memory as a function of rate of presentation and individual differences in test anxiety. Bulletin of the Psychonomic Society, 1978, 12, 133-136.

Mueller, J. H., & Courtois, M. R. Test anxiety and breadth of encoding experiences in free recall. Journal of Research in Personality, 1980, 14, 458-466.

Mueller, J. H., & Overcast, T. D. Free recall as a function of test anxiety, concreteness, and instructions. Bulletin of the Psychonomic Society, 1976, 8, 194-196.

Nottleman, I. D., & Hill, K. T. Test anxiety and off-task behavior in evaluative situations. Child Development, 1977, 48, 225-231.

Osterhouse, R. A. Desensitization and study skills training as treatment for two types of test anxious students. Journal of Counseling Psychology, 1972, 19, 301-307.

Raven, J. C. Advanced Progressive Matrices, Sets I and II, London: H. K. Lewis, 1965. (a)

Raven, J. C. Standard Progressive Matrices Manual. London: H. K. Lewis, 1965. (b)

Ribordy, S. C., Tracy, R. J., & Bernotas, T. D. The effects of an attentional training procedure on the performance of high and low test-anxious children. Cognitive Therapy and research, 1981, 5, 19-28.

Richardson, F. C., O'Neil, H. G., Whitmore, S., & Judd, W. A. Factor analysis of the test anxiety scale and evidence concerning the components of test anxiety. Journal of Consulting and Clinical Psychology, 1977, 45, 704-705.

Richardson, F. C., & Suinn, R. A comparison of traditional systematic desensitization, accelerated massed desensitization, and anxiety management training in the treatment of mathematics anxiety. Behavior Therapy, 1973, 4, 212-218.

Russell, R. K., & Sipich, J. F. Cue-controlled relaxation in the treatment of test anxiety. Journal of Behavior Therapy and Experimental Psychiatry, 1973, 4, 47-49.

Sarason, I. G. Interrelationships among individual difference variables, behavior, in psychotherapy and verbal conditioning. Journal of Abnormal and Social Psychology, 1958, 56, 339-344.

Sarason, I. G. Experimental approaches to test anxiety: Attention and the uses of information. In C. D. Spielberger (Ed.,), Anxiety and behavior (Vol. 2), New York: Academic Press, 1972.

Sarason, I. G. Anxiety and self-preoccupation. In I. G. Sarason & C. D. Spielberger (Eds.), Stress and anxiety (Vol. 2), Washington: Hemisphere Press, 1975.

Sarason, I. G. The Test Anxiety Scale: Concept and research. In C. D. Spielberger & I. G. Sarason (Eds.), Stress and anxiety (Vol. 5). Washington, D. C.: Hemisphere, 1978.

Sarason, I. G. Introduction to the study of test anxiety. In I. G. Sarason (Ed.), Test anxiety: Theory, research, and applications. Hillsdale, N.J.: Erlbaum, 1980.

Sarason, I. G. Test anxiety, stress, and social support. Journal of Personality, 1981, 49, 101-114.

Sarason, I. G., & Ganzer, V. J. Effects of test anxiety and reinforcement history on verbal behavior. Journal of Social Psychology, 1962, 67, 513-519.

Sarason, I. G., Pederson, A. M., & Nyman, B. Test anxiety and the observation of models. Journal of Personality, 1968, 36, 493-511.

Sarason, I. G., & Stoops, R. Test anxiety and the passage of time. Journal of Consulting and Clinical Psychology, 1978, 46, 102-109.

Sarason, S. B., Davidson, K. S., Lighthall, F. F., Waite, R. R., & Ruebush, B. K. Anxiety in elementary school children. New York: Wiley, 1960.

Sarason, S. B., & Mandler, G. Some correlates of test anxiety. Journal of Abnormal and Social Psychology, 1952, 47, 810-817.

Sarason, S. B., Mandler, G., & Craighill, P. G. The effect of differential instruction on anxiety and learning. Journal of Abnormal and Social Psychology, 1952, 47, 561-565.

Schachter, S., & Singer, J. E. Cognitive, social and physiological determinants of emotional state. Psychological Review, 1962, 69, 379-399.

Scheier, M. D., Carver, C. S., & Gibbons, F. X. Self-focused attention and reactions to fear. _Journal of Research in Personality_, 1981, _15_, 1-15.

Schneider, W., & Shiffrin, R. M. Controlled and automatic human information processing: I. Detection, search, and attention. _Psychological Review_, 1977, _84_, 1-66.

Seligman, M. E. P. _Helplessness_. San Francisco: W. H. Freeman, 1975.

Shaw, B. E. The role of faulty thinking style and imagery ability in cognitive restructuring of test anxiety (Doctoral dissertation, Indiana University, 1980). _Dissertation Abstracts International_, 1980, _41_, 1526B-1527B. (University Microfilms No. 8022717)

Sieber, J. E. Defining test anxiety: Problems and approaches. In I. G. Sarason (Ed.), _Test anxiety: Theory, research, and applications_. Hillsdale, N.J.: Erlbaum, 1980.

Slapion, M. J., & Carver, C. S. Self-directed attention and facilitation of intellectual performance among persons high in test anxiety. _Cognitive Therapy and Research_, 1981, _1_, 115-121.

Spence, J. T., & Spence, K. W. The motivational components of manifest anxiety: Drive and drive stimuli. In C. D. Spielberger (Ed.), _Anxiety and behavior_. New York: Academic Press, 1966.

Spielberger, C. D. Theory and research on anxiety. In C. D. Spielberger (Ed.), _Anxiety and behavior_. New York: Academic Press, 1966.

Spielberger, C. D. Conceptual and methodological issues in research on anxiety. In C. D. Spielberger (Ed.), _Anxiety: Current trends in theory and research_, (Vol. 1). New York: Academic Press, 1972. (a)

Spielberger, C. D. Anxiety as an emotional state. In C. D. Spielberger (Ed.), _Anxiety: Current trends in theory and research_, (Vol. 2). New York: Academic Press, 1972. (b)

Spielberger, C. D. _Preliminary test manual for the Test Anxiety Inventory_. Palo Alto, Calif.: Consulting Psychologists Pr-ss, 1980.

Spielberger, C. D., Anton, W. D., & Bedell, J. The nature and treatment of test anxiety. In M. Zuckerman & C. D. Spielberger (Eds.), _Emotion and Anxiety: New concepts, methods, and applications_. New York: Wiley, 1976.

Spielberger, C. D., Gonzalez, Taylor, C. J., Algaze, B., & Anton, W. D. Examination stress and test anxiety. In C. D. Spielberger & I. G. Sarason (Eds.), _Stress and anxiety_. Washington, D. C.: Hemisphre/Wiley, 1978.

Spielberger, C. D., Gorsuch, R. L., & Lushene, R. E. _Manual for the State-Trait Inventory_. Palo Alto, Calif.: Consulting Psychologists Press, 1970.

Suinn, R. M. The STABS, a measure of test anxiety for behavior therapy: Normative data. _Behaviour Research & Therapy_, 1969, _7_, 335-339.

Suinn, R. M., & Richardson, F. Anxiety management training: A nonspecific behavior therapy program for anxiety control. _Behavior Therapy_, 1971, _2_, 498-510.

Tobias, C. D. A model for research on the effect of anxiety on instruction. In J. E. Sieber, H. D. O'Neill, Jr., & S. Tobias (Eds.), Anxiety, learning, and instruction. Hillsdale, N.J.: Erlbaum, 1977.

Tobias, S. Anxiety research in educational psychology. Journal of Educational Psychology, 1979, 71, 573-582.

Tobias, S. Anxiety and instruction. In I. G. Sarason (Ed.), Test anxiety: Theory, research, and applications. Hillsdale, N.J.: Erlbaum, 1980.

Van der Ploeg, H. M. Relationship of state-trait anxiety to academic performance in Dutch medical students. Psychological Reports, 1979, 45, 223-227.

Wachtel, P. L. Anxiety, attention, and coping with threat. Journal of Abnormal Psychology, 1968, 73, 137-143.

Wechsler, D. Manual for the Wechsler Adult Intelligence Scale. New York: The Psychological Corporation, 1958.

Weiner, M. J., & Samuels, W. The effect of attributing internal arousal to an external source upon test anxiety and performance. Journal of Social Psychology, 1975, 96, 255-265.

West, C. D., Lee, J. D., & Anderson, T. H. The influence of test anxiety on the selection of relevant from irrelevant information. Journal of Educational Research, 1969, 63, 51-52.

Whitney, S. M. Cognitive and relaxation coping skills in the reduction of test and other anxieties (Doctoral dissertation, University of Missouri, 1979). Dissertation

Abstracts International, 1980, 40, 4905A. (University Microfilms No. 8007204)

Wilson, T. D., Hull, J. G., & Johnson, J. Awareness and self-perception: Verbal reports of internal states. Journal of Personality and Social Psychology, 1981, 40, 53-71.

Wine, J. Test anxiety and direction of attention. Psychological Bulletin, 1971, 76, 92-105.

Wine, J. D. Cognitive-attentional theory of test anxiety. In I. G. Sarason (Ed.), Test anxiety: Theory, research, and applications. Hillsdale, N.J.: Erlbaum, 1980.

Wise, E. H. Cognitive treatment of test anxiety: Rational restructuring versus attentional training (Doctoral dissertation, Southern Illinois Unversity, 1980). Dissertation Abstracts International, 1981, 41, 3203B-3204B. (University Microfilms No. 8102442)

Wittmaier, B. Test anxiety and study habits. The Journal of Educational Research, 1972, 65, 852-854.

Wolpe, J. Psychotherapy and reciprocal inhibition. Stanford: Stanford University Press, 1958.

Yerkes, R. M., & Dodson, J. D. The relation of strength of stimulus to rapidity of habit formation. Journal of Comparative Neurology and Psychology, 1908, 18, 459-482.