DTIC FILE COPY

ARI Research Note 90-106

AD-A226 194

Test Anxiety and Post Processing Interference

Sigmund Tobias
City University of New York

for

Contracting Officer's Representative
Judith Orasanu

Basic Research
Michael Kaplan, Director

August 1990

1990

United States Army
Research Institute for the Behavioral and Social Sciences

Approved for public release; distribution is unlimited

U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency Under the Jurisdiction of the Deputy Chief of Staff for Personnel

EDGAR M. JOHNSON
Technical Director

JON W. BLADES
COL, IN
Commanding

Research accomplished under contract for
the Department of the Army

City University of New York

Technical review by

George W. Lawton

A-1

QUALITY INSPECTED 4

NOTICES

DISTRIBUTION: This report has been cleared for release to the Defense Technical Information Center (DTIC) to comply with regulatory requirements. It has been given no primary distribution other than to DTIC and will be available only through DTIC or the National Technical Information Service (NTIS).

FINAL DISPOSITION: This report may be destroyed when it is no longer needed. Please do not return it to the U.S. Army Research Institute for the Behavioral and Social Sciences.

NOTE: The views, opinions, and findings in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other authorized documents.

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS —
2a. SECURITY CLASSIFICATION AUTHORITY —	3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE —	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) —	5. MONITORING ORGANIZATION REPORT NUMBER(S) ARI Research Note 90–106
6a. NAME OF PERFORMING ORGANIZATION City College City University of New York 6b. OFFICE SYMBOL (If applicable) —	7a. NAME OF MONITORING ORGANIZATION U.S. Army Research Institute for the Behavioral and Social Sciences
6c. ADDRESS (City, State, and ZIP Code) 138th & Convent. Ave. New York, NY 10031	7b. ADDRESS (City, State, and ZIP Code) Office of Basic Research 5001 Eisenhower Ave (PERI-BR) Alexandria, VA 22333-5600
8a. NAME OF FUNDING / SPONSORING ORGANIZATION U.S. Army Research Institute 8b. OFFICE SYMBOL (If applicable) PERI-BR	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER MDA903–82-C-0353
8c. ADDRESS (City, State, and ZIP Code) 5001 Eisenhower Avenue Alexandria, VA 22333–5600	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. 61102B PROJECT NO. 74F TASK NO. NA WORK UNIT ACCESSION NO. NA

11. TITLE (Include Security Classification)
Test Anxiety and Post Processing Interference

12. PERSONAL AUTHOR(S)
Tobias, Sigmund

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Interim	FROM 82/09 TO 86/09	1990, August	23

16. SUPPLEMENTARY NOTATION
Judith Orasanu, contracting officer's representative

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Acquisition, Anxiety, Free recall, Learning, Retrieval

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This study examined whether test anxiety interfered with retrieval of prior learning, or instead if defective study skills lead to poor acquisition. In a free recall list learning paradigm 69 students learned a list of 18 words composed of three categories to a criterion of perfect recall. A similar second list was exposed for three trials. The results provided clear-cut evidence for interference in the retrieval of prior learning by test anxiety and weaker evidence for the influence of study skills. Study skills were unrelated to acquisition indices.

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Judith Orasanu	22b. TELEPHONE (Include Area Code) (202) 274–5590 22c. OFFICE SYMBOL PERI-BR

DD FORM 1473, JUN 86 *Previous editions are obsolete.* SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

Test Anxiety and Post Processing Interference

Sigmund Tobias

The interfering effects of test anxiety on student learning have been frequently demonstrated. Reviews of this literature (Sarason, 1980) indicate that students high in test anxiety obtain lower scores on cognitive tasks than their low anxiety counterparts. The mechanisms by which anxiety interferes in performance are, however, subject to different interpretations. An interference formulation (Wine, 1971; Sarason, 1972) suggests that the evaluative threat posed by the testing situation interferes with students' retrieval of prior learning. Alternatively, a deficit interpretation maintains that the reduced performance of anxious students is caused by poor study or test taking skills which impair students' learning. The purpose of this study was to test these alternate interpretations.

Interference Effect

A model for research on anxiety in instructional situations (Tobias, 1977; 1979) proposed that the affective anxiety construct can only have indirect effects on performance by impacting on the cognitive processes controlling learning and retention. The model hypothesized that anxiety was most likely to affect performance at three points: preprocessing, during processing and post processing of instruction. At post processing anxiety was hypothesized to interfere with the retrieval of previously learned material. Post processing interference is frequently reported phenomenologically by students who claim to "freeze up" on examinations, because they are unable to recall prior learning. A review of the literature found few direct

experimental studies of this effect, hence this investigation aimed to examine the post processing effect empirically.

Tobias' (1977, 1979) model attempted to specify the points in the instructional sequence when interference by anxiety occurred, and the sources of such interference. It was assumed that one of the mechanisms by which performance during testing was impaired was the alteration of attention hypothesized by both Wine (1971) and Sarason (1972). This formulation maintained that highly test anxious individuals divide their attention between task relevant and task irrelevant cognitions (composed principally of negative personal preoccupations, worry, and fear of failure) to a greater degree than less anxious individuals. In turn, the alteration of attention is presumed to interfere with the retrieval of previous learning.

The research supporting the deficit formulation (Sieber, O'Neil & Tobias, 1977; Sarason, 1980) consisted of findings reporting reduced performance in evaluative situations by highly anxious students compared to their low anxiety counterparts. Typically these studies do not provide evidence differentiating between performance at acquisition and at retrieval while students are tested. The absence of such evidence makes it difficult to specify whether reduced functioning is attributable to interference at acquisition or at retrieval.

Wendell and Tobias (1983) examined the acquisition-retrieval distinction. Students viewed six modules dealing with course relevant content, received pre- and posttests for each module, and a summative posttest (containing all the items from the module posttests) six weeks later. Two indices of retrieval from long term memory, composed

of items passed on module tests yet failed on the delayed posttest were calculated. The correlation between test anxiety and the first retrieval index was .22 (p. =<.05); a second retrieval index yielded nonsignificant results.

A major difficulty with the Wendell & Tobias (1983) study was that immediate posttest items dealt with content covered at various points in the modules which lasted an average of about 35 minutes. Module posttests were intended to tap working memory while the delayed posttest was considered to measure recall from long-term memory. However, since some proportion of the content tapped by the module test items may have been acquired over half an hour earlier, these items could be conceived as assessing long term memory at two different points in time. A more clearcut test of interference with either acquisition or retrieval was, therefore, planned in this study.

Deficit Model

A number of studies questioned both the interference model and the occurrence of post processing interference. Kirkland and Hollandsworth (1979) found that test anxiety scores correlated significantly with study skills. It had previously been demonstrated by Desiderato and Koskinnen (1968), by Wittmaier (1972), and by Mitchell and Ng (1972) that anxious students had less effective study skills than those lower in anxiety. Kirkland and Hollandsworth (1979) then raised "the question whether anxiety interferes with effective test taking behavior or whether the lack of effective study skills results in anxiety" (p. 435).

Culler and Hollahan (1980) also found that "high test- anxious students who have developed and exercise better study skills did better academically than those with poor study habits. . . . The

findings . . . .tend to contradict the common stereotype of the high test anxious student who knows the subject matter but 'freezes up' at test time" (p. 18). High anxious students spent more time studying than those lower in anxiety, and study time was significantly correlated with grade point average for high test anxious students but not for those lower in anxiety, suggesting that anxious students may compensate for poor skills by studying more.

Benjamin, McKeachie, Lin, and Hollinger (1981) found that high test anxious subjects had significantly poorer scores on multiple choice tests (considered an index of storage) and on fill-in tests (considered a retrieval index) than those lower in anxiety. High anxiety students reported more problems both while learning and reviewing. Anxious students also had lower scores on fill-in than on multiple choice tests, suggesting to these investigators that test anxiety interfered more with retrieval than with storage. In an analysis of covariance with fill-in scores as the covariate and multiple choice scores as the dependent variable performance differences between anxiety groups disappeared. These results were interpreted to suggest that retrieval, at least as measured by short answer, fill-in tests, appeared to be more of a problem for test anxious students than storage and encoding of instructional content. In a second study Benjamin et al found that the higher the test anxiety the greater the difficulties reported in initial learning, in reviewing, and in remembering on examinations.

Summary and Rationale

There is research support for both the interference and deficit formulations. In general, the findings do <u>not</u> clearly support one

interpretation and refute another; possibly both effects contribute variance to the reduced test performance of students. In order to clarify the relative contributions of these phenomena a task was required which clearly differentiated between what was learned at acquisition, and how much of that was recalled when students are tested later, i.e., when prior learning has to be retrieved. While it is difficult to implement such a distinction in typical classrom learning contexts, laboratory tasks can be created to test this distinction. For these reasons a list learning-free recall paradigm was employed in this experiment. Students were required to learn a list of meaningful words to mastery and, after an interpolated task, were later tested to determine their recall of the previously learned words.

It can be predicted from the interference model that anxiety induced by the testing situation should interfere with the retrieval of previously learned words at test time. The study skills deficit model, on the other hand, hypothesizes that test performance is impaired by less thorough initial learning. Hence, students with poor study skills should have impaired acquisition. Once a word list is mastered, however, poor study skills should not interfere with test performance. According to the deficit model, elevation in test anxiety during acquisition or evaluation are observed because students with poor study skills have a metacognitive (Flavell, 1979) awareness of how poorly prepared they are. In this view, anxiety is a consequence of this awareness, rather than the source of interference in performance. For these reasons, students' metacognitive awareness was also assessed in this study.

Method

Students studied a word list until they recalled it perfectly and were then presented with various interpolated tasks; delayed recall of the first list was, then, one clear cut index of retrieval from long term memory. In order to create interference for recall, and emulate a learning situation in which students studied for several courses consecutively and were then evaluated on these, a second list was administered for three trials. Following the administration of a study skills questonnaire, stress was induced, and recall of both lists requested.

Pilot Studies

Three pilot studies were conducted. In the first (n=5) a list of 21 words, in three categories, had to be remembered to a criterion of two complete trials. After criterion was reached, subjects completed some questionnaires. Recall after the interpolated task was almost perfect. In order to generate more variablility a second set of subjects (n=5) was asked to learn the list to a criterion of only one error free trial. With this modification performance was still very high.

In a further pilot study (n=5) a second list of 18 words, composed of three categories similar to those used in list 1, was developed as an interpolated task, in addition to requiring students to complete some questionnaires. Since performance with these procedures generated more variability, they were adopted for the final investigation.

Subjects

A total of 69 students, (37 female) participated in this

experiment. Students were recruited from two campuses of a large urban university. On one campus students had originally volunteered for a different investigation, and were paid $7.50 for their participation. On the second campus, student volunteers were not paid.

Procedures

At one of the two campuses the Test Anxiety Scale (Sarason, 1972) and the Worry-Emotionality (Morris, Davis & Hutchings, 1981) measures were administered during an initial testing session, together with a number of other research instruments. At the second site, these anxiety scales were administered first, followed by the experimental materials. The rest of the procedures were identical at both sites.

List 1 consisted of 18 words divided into three categories. An animal category consisted of the following words: wolf, lion, bear. monkey, tiger and elephant. A clothing category included these words: sweater, shirt, belt, coat, glove, and shoe. Finally, a fruit category contained these words: lemon, fig, banana, plum, pear, and melon. The words were arranged in four different random sequences so as to avoid positional cues. Subjects exceeding four trials were administered the four sequences in order until criterion was reached. Students studied each list for 30 seconds and were then asked to write down all the words they could remember, until all words were recalled. At the end of every trial, students were asked to estimate how many of the words recalled were accurate.

The second list contained the following categories and words: a bird category was composed of : robin, chicken, sparrow, eagle, hawk, and pigeon. A vegetable category included: carrot, potato, corn, lettuce, spinach and bean. A parts of the body category contained

thumb, knee, foot, elbow, shoulder and head. All of the procedures for List 2 were identical to List 1 except that only three trials were required; if students recalled the list before the third exposure, trials were terminated. The time taken by students on each list was recorded.

The Worry-Emotionality Scale was administered after the first list with instructions for students to respond the way they felt while studying the words, as were some other research scales. The following subscales from Weinstein's (1983) Learning and Study Strategies Inventory were administered after List 2: Information Processing-Elaboration, Concentration, Selecting Main Ideas, and Self-Test.

The following instructions were then read: "Students' biggest problem in succeeding in school is remembering what they have learned when they take a test, especially when they have learned similar things in other courses. Our research is similar to that. We found that students who do well on our tasks also do well on tests in school. We now want you to write down as many of the words as you can remember from the first list. Try as hard as you can." Recall of both lists was then requested. Finally, the Worry-Emotionality Scale was readministered with instructions to respond the way students felt during delayed recall.

Results

The words recalled were scored for clustering using the modified ratio of repetition procedure (Hubert & Levin, 1976). The means and standard deviations for the major variables are displayed in Table 1. It should be noted that due to some missing data, ns for each of the variables varied slightly. An initial analysis indicated that there

were no differences between data collected at alternate sites so these results were pooled. Preliminary analysis also indicated no sex differences on any of the anxiety or study skills scales, so these data were combined as well.

Insert Table 1 about here

The data were analyzed by multiple regression analysis. Two procedures were computed for each of the major dependent variables. In one analysis, utilizing the "test" procedure of the SPSS "New Regression" program (Hull & Nie, 1981), a full model was formed and the three anxiety and four study skills scales skills tests then removed to test their contributions to dependent variables. Since this procedure might obscure the contribution of one or two single tests by entering both sets of measures, stepwise regression analyses were also computed for each of the dependent variables. In the stepwise analysis only variables with significant ($p. < .05$) effects on the dependent variables could enter the equation. Table 2 presents the results of these analyses.

Insert Table 2 about here.

A final regression analysis was computed to determine whether the presence of four separate study skills subtests and three anxiety indices might have diluted a prominent overall effect. The scores on each of the study skills and anxiety indices were converted to standard scores, and then summed yielding both a composite study skills and test anxiety score. This analysis yielded substantially

Table 1. Means, SDs, and Ns, for Various Variables.

	Mean	SD	n
Acquisition Data			
No. of Trials, List 1	8.30	4.29	69
Mean Words Recalled, List 1	14.75	3.56	69
Mean Words Recalled, List 2	12.57	2.13	65
Time, List 1	25.39	14.32	69
Time, List 2	7.83	3.75	69
Mean Cluster Score, List 1	.71	.20	69
Mean Cluster Score, List 2	.78	.19	65
Retrieval Data			
No. of Words Delayed Recall List 1	16.23	2.10	69
No. of Words Delayed Recall List 1	14.07	3.06	69
No. of Words Passed on Acquisition, Failed on Recall (List 2)	1.81	1.79	69
Study Skills			
Information Processing-Elaboration	58.28	10.66	69
Concentration	19.88	4.51	69
Selecting Main Ideas	9.84	2.32	69
Self-Testing	23.32	4.73	69
Age	26.10	8.17	66
TAS	14.87	6.74	69
Worry 1	6.74	2.96	69
Emotionality 1	6.97	2.86	69
Worry 2	8.17	3.68	69
Emotionality 2	8.30	3.43	69
Worry 3	7.17	3.01	69
Emotionality 3	7.09	3.21	69

Table 2. Results of Multiple Linear Regression and Stepwise Regression Analyses for the Effects of Anxiety Scales and Study Skills Measures On Various Dependent Variables.

Dependent Variables	Multiple Regression Analysis		Stepwise Regression Analysis	
	Anxiety Scales[1]	Study Skills[2]	Variable	F
Acquisition Data				
No. of Trials, List 1	<1	<1		
Time, List 1	1.67	1.40	Worry 2	8.25**
Time, List 2	3.16*	1.18	Worry 3	7.97**
Mean Clustering, List 1	<1	<1		
Mean Clustering, List 2	<1	<1		
Mean Recall, List 1	2.61[3]	1.18		
Mean Recall, List 2	1.41	<1		
Retrieval Data				
Delayed Recall, List 1	2.41[4]	<1	Worry 3	6.74**
Delayed Recall, List 2	2.86*	2.42*		
List 2, Words passed on Acquisition, Failed Recall	3.82*	2.41[3]	Worry 3	5.20*

1) TAS, Worry and Emotionality Scale, df=3.

2) Information Processing-Elaboration, Concentration, Selecting Main Idea, and Self-Test Scales, df=4.

3) p = .06

4) p = .07

* p = .05

** p = .01

similar results to those reported in Table 2.

After the first trial there was little variability in student responses to the metacognitive question, i.e., how many of the words recalled were correct. Students routinely responded with the number of words they had recalled on that trial. Responses to these questions were also unrelated to any of the study skills or test anxiety measures.

Discussion

The results indicated little effect of anxiety or study skills on acquisition or clustering measures for List 1, though Worry was significantly related to time spent on both lists and to retrieval of List 1. For the second list both anxiety and study skills had moderate effects on retrieval indices, with those of anxiety appearing more prominent. The implications of these results for the anxiety-study skills issue will be discussed below.

Anxiety, Study Skills, and Retrieval from Long-Term Memory

The fact that none of the anxiety indices were significantly related to the number of trials required to achieve mastery on List 1 may be be explained by the fact that ego involving, sometimes also called stress inducing, instructions were not introduced until delayed recall. At that time students were informed that task performance was analagous to studying for college courses and that success on the task was related to school achievement. There is considerable evidence in the anxiety literature (Wine, 1971; Sarason, 1972, 1980) that differences between high and low test anxious students occur mainly in the presence of such instructions. The findings of significant effects by anxiety on most of the retrieval indices once stress was introduced tends to confirm this interpretation. It should be noted

that this ratonale cannot be invoked to explain the lack of significant effects by any of the study skills scales on acquisition.

There is strong evidence in the results for interference by anxiety in retrieval of prior learning, and somewhat weaker evidence for the influence of study skills on such retrieval. These results will first be discussed individually, followed by a more general discussion.

Postprocessing interference. Stepwise regression analysis indicated that the worry component of test anxiety exerted a significant influence on the recall of previously mastered words on both lists. This is clearcut evidence of interference by test anxiety in retrieval of prior learning. The effect of worry on the delayed recall of List 1 indicated that anxious students had more difficulty retrieving this previously mastered material than those less worried. Stepwise regression also indicated that worry exerted a significant effect on the recall of previously mastered words from the second list, as did the total set of anxiety indices. Since these List 2 words had been mastered on acquisition and were not remembered on delayed recall, following stress induction, these results provide clear evidence for the influence of anxiety on the retrieval of previously learned material, confirming the suggestions in the Benjamin et al (1981) and the Wendell and Tobias (1983) studies.

In this study the effects of anxiety on acquisition and retrieval were differentiated. The results therefore, provide the first empirical evidence in support of students' reports of "freezing up" during evaluation and being unable to recall previous learning. These also data confirm the post processing interference section of Tobias' (1977, 1979) model. It should be noted that anxiety accounted for

only 7-9% of the variance in retrieval and that study skills also contributed variance to these effects.

Study Skills. The data indicate that study skills had no influence on acquisition of either list, though moderate effects on some of the retrieval indices for the second list were found. Thus, study skills had a marginally significant influence on the retrieval of previously learned words from the second list, and on the total number of words recalled from that list. In general, these findings fail to support predictions from the study skills deficit model.

It should be noted that Weinstein's (1983) questionnaire deals with studying behavior in meaningful instructional situations. Examining their effect on the acquisition, retrieval or clustering of meaningful words assumed that the study skills employed in classroom situations applied to this task. There is some evidence supporting this assumption. Thus, the effects of study skills were greater on the recall of the second list than the first. It is reasonable to suppose that students with effective study skills were more able to apply whatever strategy they had developed on the first list to the second than students with poorer skills. The increase in relationships with study skills for the second list suggested that the skills assessed by the questionnaire were relevant to the task. It is important to note, however, that study skills exerted mild effects on the retrieval of prior learning of List 2, rather than on its acquisition. Such effects were, not expected from the study skills deficit formulation.

The cluster index computed for acquisition and retrieval of both lists can be conceptualized as a study skill more directly relevant to the task than the skills assessed by questionnaire. The index

evaluated the degree to which students recalled words composed of the categories making up both lists. It had been assumed that students who organized the words into such clusters would have superior acquisition and retrieval. In general, these expectations were not confirmed for List 1. The mean cluster score for this list was related only to the ammount of time required for mastery (r =-.33, $p<.01$), and not related to number of trials to mastery, or to the mean number correct per trial.

There were some significant relationships between cluster score and number of indices from the second list. For example, cluster score correlated .30 with mean number of words correct during all trials, .28 with number of words at delayed recall, and -.39 with time required, all significant beyond the 05 level. Apparently, much like the study skills questionnaire, the task relevant clustering skill had more significant relationships with data for the second list than with the first. The similarity of results for this task relevant skill, and the study skills assessed by questionnaire provides further evidence for the relevance of the study skills questonnaire to the task.

Relationships between the cluster scores and both test anxiety and study skills indices were generally not significant. Possibly, subjects did not become aware that the words could be organized into clusters until the second list, an interpretation supported by the slight rise in mean clustering index from .71 to .78 for the second list. It is also possible that students did not realize the advantage of clustering until the second list. This interpretation is supported by the correlation of .30 ($p<.01$) between mean cluster score and mean number of words recalled for the second list, compared to the

correlation of -.07 for those data in the first list. These differences in relationships between study skills for the first and second lists may also have occurred because List 1 was studied until mastery, whereas the second list was presented only three times. Further research is required to clarify these possibilities.

Grade point averages were obtained for all students, but were generally unrelated to the independent or dependent variables. This finding may be attributable to several factors. First, error may have been introduced by the fact that the samples were recruited from two different campuses. Furthermore, many of the students had transferred from community to senior colleges. The grade point averages of these students were, thus, based on the relatively small number of credits completed at the senior campus, and subject to lack of stability.

The deficit formulation explains elevations of anxiety during evaluative situations as being attributable to student's awareness of inadequate initial mastery. In this study such metacognitive knowledge was assessed by asking students on every trial how many of the words recalled were correct. After the first few trials, students routinely responded to this question with the number of words they had recalled (correlations between the metacognitive question and number of words recalled for the first three trials were .77, .83, and .88). Responses to these metacognitive questions were unrelated to either anxiety, or study skills. These results also fail to confirm the expectations of the deficit approach.

The metacognitive questions employed in this study may have had an unanticipated effect by allowing students to focus on the number of words recalled and missed to a greater degree than they otherwise would have. Observations indicated that after the first few

metacognitive questions students typically counted the number of words recalled, and often counted the words on the stimulus list as well. Apparently, these questions provided cues to students facilitating their learning.

In summary a number of the results failed to confirm expectations of the study skills deficit formulation. These included: 1) No effect of study skills on acquisition. 2) A weak effect of study skills on retrieval. 3) No relationship between clustering and most acquisition indices for the first list. 4) No relationships between metacognitive questions and anxiety, or study skills scores.

Anxiety, Study Skills and Cognitive Capacity

The results suggest that it is premature to conclude that a study or test taking skills deficit should replace the test anxiety construct, as suggested by Kirkland & Hollandsworth (1980). A great percentage of the variance in this complex phenomenon is still unexplained, and both variables appear to exert modest effects on the retrieval of previous learning, with the effects of worry, a component of test anxiety, being more prominent.

Tobias (In press) hypothesized that anxiety and study skills may have complementary effects. The cognitive representation of test anxiety, i.e., the negative preoccupations worry over task success, and fear of failure, can be assumed to absorb some information processing capacity, leaving a reduced amount for task solution. High anxiety, then, probably absorbs a greater proportion of cognitive capacity than lower anxiety leaving a lesser proportion for task solution, thus leading to the observed interference by anxiety in performance. Study skills, on the other hand, may serve to reduce the information processing capacity required by the task. Students with

good study skills can probably use a variety of strategies to reorganize a task, or relate it to previously mastered materials to reduce the information processing demands of the task.

The limited capacity formulation clarifies some of the results of the present study. Neither anxiety nor study skills affected acquisition indices such as number of trials, or the cluster scores. Since stress was not induced at acquisition, it may be assumed that anxiety was not engaged at that time, hence information processing capacity was probably not reduced by anxiety related preoccupations. Furthermore, the lists were composed of words, having a high frequency of occurrence and probably demanded little processing capacity. Retrieval of previously learned words, on the other had, may have demanded greater information processing capacity than acquisition. The stronger effects of both anxiety and study skills on retrieval supports this reasoning.

In view of the fact that the retrieval indices had limited variability, and that recall was at a high level the relationship of worry to these measures was probably attenuated. One could expect that in a situation in which the dependent variables had greater variability, these relationships may well be somewhat stronger than presently observed. A suggestion for further research would be to utilize words of lower meaningfulness, or to generate more interference from an interpolated list. Such procedures would demand more cognitive capacity, hence interference by anxiety, or facilitation by study skills should be more likely to occur. In such a situation one could expect stronger relationships between anxiety, study skills, and acquisition indices, and greater effects on recall from long-term memory.

References

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

Culler, R.E., & Holahan, C. (1980). Test taking and academic performance: The effects of study-related behaviors. Journal of Educational Psychology, 72, 16-20.

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

Flavell, J. (1979) Metacognition and cognitive monitoring: A new area of cognitive developmental inquiry. American Psychologist, 34, 906-911.

Hubert, L.J., & Levin, J.R. (1976). A general statistical framework for assessing categorical clustering in free recall. Psychological Bulletin, 83, 1972-1980.

Hull, C.H., & Nie, N.H. (1981). SPSS Update 7-9. New York: McGraw Hill.

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

Kirkland, K., & Hollandsworth, J. (1979) Test anxiety, study skills, and academic performance. Journal of College Personnel, 431-435.

Mitchell, K., & Ng, K. (1979). Effects of group counseling and behavior therapy on the academic achievement of test-anxious students. Journal Counseling Psychology, 19, 491-497.

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

Sarason, I.G. (1972). Experimental approaches to test anxiety: Attention and the uses of information. In C.D. Spielberger (Ed.), Anxiety: Current trends in theory and research (Vol. 2). New York: Academic Press, Pp 381-403.

Sarason, I.G. (In press). Test anxiety, cognitive interference and performance. In R.E. Snow and M.J. Farr (Eds.), Aptitude, Learning, and instruction: Conative and affective process analyses. Hillsdale, N.J.: Erlbaum.

Sarason, I.G. (Ed.) (1980). Test anxiety; Theory, research, applications. Hillsdale, NJ:

Erlbaum Association.

Sieber, J.E., O'Neil, H.F., and Tobias, S. (1977). Anxiety, learning and instruction. Hillsdale, N.J.: Erlbaum Associates.

Tobias, S. (1977). A model for research on the effect of anxiety on instruction. In J.E. Sieber, H.F. O'Neil, Jr., & S. Tobias, Anxiety, learning , and instruction . Hillsdale, N.J.: Erlbaum, Pp. 223-240.

Tobias, S. (In press). Anxiety and cognitive processing of instruction. In R. Schwarzer (Ed.) Self-related cognitions in anxiety and motivation. Hillsdale, NJ: Erlbaum Associates.

Tobias, S. (1980). Anxiety and instruction. In I.G. Sarason (Ed.) Test anxiety, theory, research, applications. Hillsdale, N.J.: Lawrence Erlbaum Associates, Pp. 289-311.

Weinstein, C.E. (1983). Learning and study strategies inventory. (Mimeo). Austin, Texas: University of Texas.

Wendell, A., & Tobias, S. (1983, October). Anxiety and the retrieval of information from long term memory . Paper presented at the annual convention of the Northeastern Educational Research Association, Ellenville, N.Y.

Wine, J. (1971). Test anxiety and direction of attention. Psychological Bulletin, 71 , 92-104.

Wittmaier, B. (1972). Test anxiety and study habits. Journal of Educational Research , 352-354.