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ABSTRACT

The intent of this study was to determine the relationship of the independent variables of task difficulty and memory support for high and low anxious subjects on certain dependent variables: correct task performances, measured anxiety level, and self-estimated competency rating. A further purpose was to investigate the relationship of obtained scores and self-report of estimated accuracy under these treatments in order to determine effects of anxiety level upon information feedback. The experimental findings of the study did not support the Spence-Taylor Drive Theory of disordinal anxiety which proposes that competing response tendencies interfere with learner performance differential given a difficult task and an easy task; the author feels that what is needed to test the theory is a task which raises the anxiety for the high anxious subjects and not the low anxious subjects, or at least raises their anxiety level equally. The paper includes some review of the pertinent literature, graphs of the experiment's results, and references. (Author/SES)

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ANXIETY INTERACTION WITH TASK DIFFICULTY LEVELS, MEMORY SUPPORT, AND ESTIMATED TASK COMPETENCY IN A CONCEPT IDENTIFICATION TASK

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Since the early 1950's experimental psychologists have been raising some theoretical questions about relationships between learner anxiety and performance in a variety of tasks. Much of the early work was done by Spence (1958) and Taylor (1956) who hypothesized an interaction of emotional effects with cognitive factors in which highly anxious learner scores would be inferior to low anxious learner scores on a difficult task, and a reversed relationship (disordinal interaction) would exist for an easy task. They defined an easy task as one in which the correct response is easier to choose and thus stronger (more dominant) than competing incorrect responses. They defined a difficult task as one in which incorrect response tendencies seem right and thus compete strongly with the correct response.

The studies of Spence and Taylor and other subsequent studies dependent on task difficulty have needed but lacked explicitly stated procedures to govern empirical task difficulty analyses. Such procedures are necessary for accurate testing of the theory of emotional and cognitive interaction. Tennyson and Boutwell (1972) have defined a system by which an empirical base difficulty level may be assigned to a concept task. Two critical attributes of an anxiety by task interaction study are essential: (a) measured anxiety differences and (b) an empirical based task difficulty contrast. Spence and Taylor identified two sources of anxiety effects. First, they identified as Drive (D) the attribute which supports higher performance scores in tasks with few competing error responses (Spence, Farber, McFann, 1956). Their second anxiety effect, labeled Stimulus-derived (Sd), is that anxiety resulting from emotional states having a disruptive effect on personal performance. The cue aspect of Sd anxiety elicits from the subject incorrect responses based on their attention-evoking attributes of the task. That is, if the task has a relatively high number of incorrect choices which seem right, the subject with high Sd anxiety is likely to choose those responses because of their strong response-eliciting characteristics. The subject with high Sd is unable to discriminate between correct and incorrect responses when the strength of the response is strong. Spence regarded disruptive anxiety as a nuisance because it occurred only under certain task conditions and was hard to control.

The difficulty of controlling anxiety or predicting the effect of anxiety under differing levels of task difficulty is reflected in several recent studies. O'Neil, Spielberger and Hansen (1969) and Tennyson and Woolley (1972) obtained a disordinal interaction as predicted by

Spence and Taylor, while Smouse and Munz (1968), Munz and Smouse (1968), Dunn (1968), and Boutwell and Tennyson (1972) did not obtain the anxiety level by task performance disordinal interaction. One reason for the differing findings may be that anxiety has a variety of disruptive effects on learning. For example, the increased level of spurious stimulus cues ascribed to Sd anxiety traditionally has been identified as a source of interference (Child, 1954; Ramond, 1953). But spurious stimulus cues while ascribed to an increased level of Sd anxiety, also are task specific in that the cues originate from the task. Another problem is that the effect on learning associated with the effect of Sd anxiety must account for an emotional interference on the memory process and its relation to the information processing control procedures.

Memory Support vs. Non-Memory Support

High anxious subjects without self-reinforcement (memory support) are more likely to employ random strategies and make random choices (Wolfgang, 1962). Sieber, Kameya, and Paulson (1970) note that "high anxious persons are neither cautious nor accurate problem-solvers when necessary information is not available." Since the problem of memory and self-reinforcement are significant to a hypothesis of disordinal interaction, a variable termed memory support (allowing the subject to return to the learning display) has been added to the parameters of this study to ascertain the effect of anxiety on memory. It has been suggested (Boutwell, Black and Tennyson, 1972) that the difference between performance in high anxiety and low anxiety subjects may relate to the amount of self-reinforcement or memory support they receive during a task.

Measuring Self-Competency with Self-Report

If in fact the disruptive effect of anxiety does interfere with memory and the information processing system, those effects can be estimated by comparing the subject's obtained performance score and his feelings of success in the task. Tulving and Madigan (1970) indicate that a genuine breakthrough in memory study will require research on how much people know about what's stored in their own memories. Several models of the memory system (Norman, 1968; Shiffrin and Atkinson, 1969; Reitman, 1965) indicate that the decision-making process including self-knowledge of performance accuracy is functionally independent of the memory process. Rosenberg (1963) and Pilisuk (1963) discovered that the subject's report of performance information and its accuracy relate to the variable of self-esteem. These two studies also found that self-rating of self-esteem was inversely related to measured anxiety. If self-esteem correlates negatively with measured anxiety, then one would expect the subjects with high anxiety to report lower scores than actual performance and thus underestimate their scores. Such a conclusion is supported in a study made by Boutwell, Black, and Tennyson (1972). If this correlation continues and is found to be reliable, self-report could serve as a new tool for measuring anxiety. Problems in establishing reliability of self-report are discussed in greater detail in Boutwell and Black (1972) in which applications of this procedure are examined.

The intent of this study was to determine the relationship of the independent variables of task difficulty and memory support for high and low anxious subjects on certain dependent variables: correct task performance, measured anxiety level, and self-estimated competency rating.

A further purpose was to investigate the relationship of obtained scores and self-report of estimated accuracy under these treatments in order to determine effects of anxiety level upon information feedback.

Specifically, the hypotheses for the independent and dependent variables are as follows:

Task Level by Anxiety Level Hypotheses

The first and principle hypothesis under investigation is the Spence-Taylor disordinal task by anxiety interaction. Specifically, the hypothesis states that high anxious learner scores are inferior to the low anxious learner scores on a difficult task and that this phenomenon is reversed on an easy task. But to test the first hypothesis in the experiment, some secondary hypotheses are essential:

Hypothesis two concerns the competing response strength of the two tasks, or, in other words, the difficulty level of the hard and easy tasks is hypothesized to produce hard task performance scores significantly lower than easy task performance scores.

The third hypothesis states the significant anxiety difference measured initially from anxiety test one will stay relatively constant across repeated measures.

Memory Condition

Hypothesis four involves the increased level of memory support that is, being able to return to the prompted examples and non-examples, is hypothesized to be associated with higher performance scores regardless of anxiety level.

Hypothesis five conjectures that the memory support condition, returning, will be associated with fewer differences between the hard and easy task performance scores regardless of anxiety level.

The sixth hypothesis is: the memory support condition, returning, will have an inverse relationship to measured anxiety level.

Self-Report

The subject's accuracy of estimated task scores will be inversely related to measured anxiety level, according to the seventh hypothesis. Low anxious subjects will estimate higher task scores than the actual obtained score while high anxious subjects will report lower estimated performance scores.

Finally, for hypothesis eight, the memory support condition, returning, should be associated with increased, estimated task performance scores regardless of measured anxiety level.

Methods

Subjects

The subjects were 168 students chosen from undergraduate educational psychology and general psychology classes at Brigham Young University who were randomly assigned experimental treatments. No one experimental group had a disproportionate number of males to females. The range of ages within these groups was from 19-27 years.

Task

The behavioral objective for this task required subjects, after reading a definition that included two prompted examples and two prompted nonexamples, to identify examples of RX_2 crystals from a list containing new examples and nonexamples. A prompted instance is one in which each attribute is individually separated, identified, and defined.

A definition (relevant attributes) of RX_2 crystals was presented to the subjects for the task, drawing their attention to the basic repeating two-to-one ratio in crystal structure of the atoms. This concept was further elaborated as follows: "for a given atom there will be another two atoms attached to it in a repeating fashion." The subjects were also told that symmetry of the crystal was irrelevant. Each page of each task consisted of a single shaded crystal picture taken from Crystal Structure by Wyskoff (1963), see Figure 1.

Insert Figure 1 about here

Instance Probability Analysis

In order to obtain empirical validation of the task difficulty level, competitive response strength of hard and easy items, Tennyson and Boutwell (1972) defined an instance probability analysis for rating and categorizing all the items of the proposed task according to how hard they were for the subjects to recognize. The concept, RX_2 crystals, identification task was formulated according to this analysis and then administered to 100 subjects from the same target population as the one used in the experiment. Each instance to be used in the task was tested for competitive response strength. High probability items, strong correct response, were those instances correctly identified by 70 percent or more of the subjects. Low probability items, strong incorrect response tendencies in competition with the correct response, were those instances correctly classified by less than 30 percent of the subjects. High probability instances in this study constituted an "easy task" and low probability instances made up the "hard task." During the treatment, all subjects received successively a hard/easy or an easy/hard segment and each segment had 14 examples and 14 nonexamples. The concept was used because the task had to be a previously unencountered concept and none of the subjects reported any previous knowledge of RX_2 crystals.

Treatments

The independent variable of memory support involves either permitting or barring subjects from returning to the RX_2 crystal definition and the prompted examples and nonexamples. The two difficulty levels of the task, hard and easy, were crossed with the two conditions of memory support. Being able to return was in effect supplying additional information to the subject since concept identification strategies may very well depend on subject self-feedback. Feedback was only possible in the memory support condition.

Each of the two tasks in the experiment were preceded by task directions, a definition of the RX_2 crystals, including their relevant attributes and two prompted exemplars and nonexemplars. The memory support versus nonmemory support condition was introduced only after the task had begun. The programs given the subjects were completely self-instructional. Responses were recorded on IBM answer sheets. No feedback was given concerning the correctness of the responses.

Anxiety Measures

The State-Trait Anxiety Inventory (Spielberger, Corsuch and Lushene, 1969) measures two anxiety dimensions: state anxiety (A-State) which fluctuates according to environmental conditions such as taking a test, and trait anxiety (T-State) which is assumed to be a relatively constant personality variable that remains stable regardless of environmental change. The test manual for the State-Trait Anxiety Inventory, reports a .75 correlation with the Institute for Personality and and Ability Testing Anxiety Scale, 1963. Since the entire experimental setting took place in an hour, the (A-State) measure was the only one used, because of its high degree of relevance to the testing situation.

The A-State (Form X-1) scale required the subjects to indicate how they felt "at the moment" by responding to twenty bi-polar items, ten of which were reversed to insure balance of the questionnaire. The subjects responded to items such as "I feel tense," according to a four-point scale: very much so (4), moderately so (3), somewhat (2), and not at all (1). The possible range of scores was from a minimum (low anxiety) of 20 to a maximum (high anxiety) of 80. The pretask anxiety scores were divided into thirds with the N-size being high - 52; medium - 59; low - 57, and with a mean score for each level being represented: high - 43; medium - 32, low - 23. These mean scores were similar to other scores reported by other studies using the A-State Inventory. Tennyson and Woolley (1972) had a high anxiety mean of 45, O'Neil et al. (1968) also reported a high anxiety score of 43.

Procedure

After being assigned to alternate desks in a large room, the subjects were administered the first of three (A-State) anxiety tests. The subject returned the first test to the experimenter to be scored; and the subjects were then placed into one of three anxiety levels: low, medium, and high. After being assigned to their initial anxiety level the subjects were randomly assigned to one of four possible treatments of the factorial design. The treatments were contained in colored coded self-instructional booklets.

The booklet introduction identified the experimenter and the department conducting the study, and followed with directions. Directions were on the method of responding to the IBM answer sheet. Next, instructions for memory support stated explicitly whether the subject could return to the prompted examples and nonexamples or not. The experimenter was always present to help ensure compliance with the instructions and to control the environmental setting. Following the instructions came the prompted examples and nonexamples pointing out the relevant and irrelevant concept attributes. The subjects then classified seven new examples and seven nonexamples for the first task. After he had identified these fourteen new instances, he was administered the second A-State Anxiety Inventory to measure how he felt during the first task. Then, starting with the memory support instructions, this procedure was repeated. A second task was taken and concluded with the third A-State Anxiety Inventory measuring how the subject felt during the second task. Finally, a self-report questionnaire was given in which the subject was asked the following question: Of the twenty-eight total crystals you have just classified as examples or nonexamples of an RX_2 crystal, how many total did you feel you correctly identified from task one and task two?

Experimental Design

Based on their first anxiety scores, the subjects were divided into three anxiety level groups and randomly assigned two conditions of task difficulty and two conditions of memory support. A measure was then made of the number of correct task scores for each condition. The (A-State) anxiety tests were administered prior to the task (anxiety test one), between the two tasks (anxie' - ɔ), and at the conclusion of the task (anxiety test three). A profile analysis was performed on these scores to measure the changes in anxiety for each of the three anxiety level groups. Finally, analysis of variance was applied to the estimated self-competency ratings and anxiety levels to measure the hypothesized interaction.

Usually in an experiment one statistical analysis is superior to most others in rejecting the Null hypothesis. This particular experimental design called for a covariance analysis to remove the bias created by differences in the initial level of anxiety and to permit the making of unbiased comparisons due to anxiety (Ostle, 1963). The analysis of covariance is commonly used where the results (Y) reflect the initial varying results of (X), where (X) is the pretask variable. Covariate analysis then, using a combination of the ideas of regression and analysis of variance, "controls" or "adjusts for" the effects of pretask variables and permits a sensitive evaluation of the experiment. This experiment meets the assumptions of analysis of covariance.

In summary, the general model for the analyses performed is a 3 x 2 x 2 factorial design with anxiety levels (high, medium, and low), task difficulty (easy vs. hard), and memory support (return vs. no-return) as factors (see Figure 2). Analyses of variance using this general model were performed to test hypotheses one, two, six, and seven. Analyses of covariance using the same general model with appropriate pretask scores for each analysis as described in the results section, were performed to test hypothesis four, five, and eight. In addition, a profile analysis was done to measure changes in anxiety (hypothesis three) for each of the three anxiety groups.

Insert Figure 2 about here

Results

Hypothesis One

Contrary to the predicted hypothesis and one of the central questions related to this study, the disordinal interaction between high/low anxiety and hard/easy task scores was not obtained.

Hypothesis Two

The effect of the different competitive response strength for the two tasks was statistically significant ($p < .01$). The mean task scores were 6.67 correct for the easy task and 11.04 for the hard task (F = -3.16, df = 1, 146).

Hypothesis Three

This hypothesis was not supported by the findings as can be seen in the profile analysis (Figure 6) for anxiety scores for low, medium, and high anxious subjects for anxiety tests one, two, and three. There was a 20 point spread between the low and high anxious subjects on the first anxiety test. On the second anxiety test the spread had dropped to 4 points. The low anxiety subjects' scores increased by 20 points on the second anxiety test. The differences between the low, medium, and high scores for anxiety test two were nonsignificant. After the third anxiety measure, the direction of anxiety had begun to return to the initial level, a nonsignificant 9 point spread ($p < .10$).

Hypothesis Four

This hypothesis was supported twice in that the results reached the same significance level using two different covariates. Figure 3 represents the first significant ($p < .05$) interaction between memory support and the second hard/easy RX_2 task two performance scores ($F = 5.58$, $df = 1, 146$), using the first RX_2 task score as the covariate. The use of RX_2 task score one as the covariate is essential since the concept identification of crystal instances in both tasks is identical. The results of the first task affect the results of the second task. As can be seen in Figure 3, the interaction between memory support condition and the second task scores indicates that memory support was associated with more correct task scores on the hard task, while non-memory support was associated with more correct task scores on the easy task.

The second support of this hypothesis occurred with the memory support and hard and easy RX_2 task two average performance score (Figure 4, dash line) which is significant ($p < .05$) using the second anxiety score as a covariate ($F = 5.44$, $df = 1, 146$). The use of anxiety test score two as the covariate is justified in that this score is a pre-measure of the subject's anxiety level prior to task two. Adjusting for the anxiety level just prior . the task did support this hypothesis in that significantly higher scores resulted under the return condition.

Hypothesis Five

Figure 5 shows the main effects of the memory condition supporting hypothesis number five and confirms the findings reported by Sieber, et al. (1970) in that memory support, using anxiety test score three as the covariate, did significantly reduce ($p < .01$) the difference between the task scores (task two minus task one), ($F = 7.35$, $df = 1, 146$). The difference under the memory support condition was 5.6 points and under the nonmemory support condition, 7.9 points. The importance of anxiety test score three as the covariate lies in the fact that this test was the final anxiety measure and presumably the most realistic measure of the subject's test anxiety. When the task differences are adjusted to this anxiety level, the main effects of memory support decreases the differences between the task scores.

Hypothesis Six

One of the purposes of this study was to determine the relationship between the independent variable of memory support and the dependent variable of anxiety level. Contrary to the predicted relationship, memory support did not significantly interact with the subjects' anxiety level. The mean anxiety difference scores averaged between the memory and nonmemory support condition was 7.2 points on the A-State Anxiety Inventory in the hypothesized direction, but the amount of variance within these scores negated that point difference.

Hypothesis Seven

The hypothesis that low anxious subjects would report the highest correct score competencies (Figure 7) was confirmed ($p < .05$) ($F = 6.54$, $df = 2, 147$). The estimated scores were also plotted against the obtained task score for task one and task two for low, medium, and high anxious subjects. The interaction between the obtained task scores and estimated task scores supported this hypothesis and was consistent with an earlier finding by Boutwell, Black and Tennyson (1972).

Hypothesis Eight

Figure 4 (solid line) shows the results of a significant ($p < .05$) subject's estimated self-competency of total task scores and the memory condition ($F = 3.92$, $df = 1, 146$). The question this result raises is why the estimated score would be significantly affected while a similar interaction with memory condition and the subject's anxiety level was not obtained.

Discussion

To further test the Spence-Taylor Drive Theory which proposes that competing response tendencies interfere with learner performance differential given a difficult and easy task, was the initial purpose of this study. According to the Spence-Taylor Theory, high anxious subjects generate a high level of Sd, the inhibiting aspect of anxiety which mistakenly drives them to the strongest response competing for their attention. Oftentimes whether the response is correct or not, the highly anxious subject will choose it because of its strength or dominance.

The experimental findings of this study did not support the Spence-Taylor Theory of disordinal anxiety by task performance hypothesis. The lack of effect is related to the findings in the anxiety profile analysis (Figure 6) and the range of the subject's anxiety over the duration of the experiment. The range of mean scores for anxiety test one given just prior to the experiment was 20 points, and after the first task, regardless of difficulty level, the range of scores on the second anxiety test was only 4 points. The high anxiety subjects' scores increased 3 points, while the low anxiety subjects' scores increased 20 points. The implication is that in order for the disordinal interaction between performance and anxiety to occur, there first must be a difference in anxiety levels, which did not exist at anxiety test two. This then must be interpreted to mean that since hypothesis three was not supported, the Spence-Taylor competing response theory was not tested since there were no differences in the subjects' anxiety during task performance. Because the anxiety test two scores following the initial task were statistically nonsignificant, they may be responsible for the generally nonsignificant findings for task one. On the other hand, the scores are beginning to return toward their respective positions by anxiety test three, which measures anxiety during task two. The difference between those scores is 9 points ($p < .10$). While no conclusions may be drawn from the nonsignificant finding as shown in the anxiety three difference scores, there does seem to be a trend toward normalization, vis-á-vis the subject's anxiety level. This trend is also evident in the post task anxiety measure of two other disordinal interaction anxieties studies (O'Neil et al., 1969; Tennyson and Woolley, 1972).

What is needed to test the theory is a task which raises the anxiety for the high anxious subjects and not the low anxious subjects, or at least raises their anxiety level equally. Herein may lie one of the fundamental problems found in many anxiety-by-task performance interactions experiments. The results may be less a function of the subject's anxiety level than the task which he is asked to complete. If this then is the case, knowing the subject's anxiety level before the task is of little instructional design value since in an instructional setting the task changes abruptly and often.

Because memory support provides an additional source of information to the subject in the completion of his task, it relieves him from memorizing or learning the material. The results reflected in Figure 3 confirms the value of the memory support condition in obtaining higher correct task scores. For the hard task condition, the memory support condition produced superior results, while the opposite was true for the easy task condition. Although these latter findings seem to negate the superiority of the memory support condition, the reason for the reversal under the easy task condition is that the subjects had to learn the hard task first and the group which scored highest on the second task was the one which had the hard task and memory support condition on the first task. This implies because the first task was hard, the subjects who had the memory support condition returned to the definition and prompted examples more often than the group with the other nonmemory support condition. To the experimenter this seemed to be the case, but no empirical methodology was set up for measurement. Returning to the definition and prompted examples seems to have helped the subjects learn the task exceptionally well, which is reflected in their superior scores on the second task. A follow-up study could measure the amount of times the memory support factor is used for the hard and easy tasks respectively.

The results reflected in Figure 4 (dash line) tend to confirm the helpfulness of memory support in that the superior scores across the hard and easy task occurred under the memory support, or return condition. The subject's feeling for memory support is also revealed in Figure 4 (solid line) where the estimated memory support scores are significantly higher than the nonmemory support, or no-return condition.

Sieber et al. (1970) discovered that task performance scores would be diminished in a problem-solving condition if one of the independent variables were memory support. Conditions were replicated for that independent variable in this study with concept identification on two task difficulty levels. For the memory support conditions, Figure 5 shows that differences between the scores (task one minus task two) were significantly diminished. Under the return condition the mean difference between task one and task two is 5.6 points, whereas under the no-return condition, the mean difference score is 7.9 points. These results support the Sieber findings and suggest fewer differences between the hard and easy task scores under the memory support condition.

The self-report finding shown in Figure 7 confirms the hypothesis that self-rating of task competencies is inversely related to anxiety level. That is, high anxiety subjects report the lowest task scores and low anxiety subjects report the highest task scores. Boutwell, Black and Tennyson (1972), Rosenberg (1963), and Pilisuk (1963) have tested the inverse hypothesis and supported its validity. These estimated scores were then compared to the combined task one and task two scores which were nonsignificant across anxiety levels.

The theoretically relevant purpose of using self-report methodology is to provide more data for creating models of the mental process learners use in solving problems. If self-report is known to be confounded with anxiety and controls are not set up to correct the confounding, self-report will be too unreliable to be of value. The proper controls, however, might make it a valuable dependent variable in the information retrieval process.

The fact that there exists a large amount of contradictory data concerning the interaction between subject anxiety and task performance is probably because interaction depends on the task and not just the subject's anxiety level. A-State anxiety level is task specific. Trait anxiety has been measured with task interaction experiments and generally has been unsuccessful in supporting the Spence-Taylor disordinal interaction theory (Boutwell and Tennyson, 1972). Future anxiety-by-task interaction studies will also be contradictory unless controls are adopted to actually measure the subject's anxiety for a particular task. What is suggested here is that, tasks may empirically be designated easy and difficult, but unless the experimenter knows the anxiety-evoking characteristics of the task beforehand, there is little certainty of the hypothesized outcome.

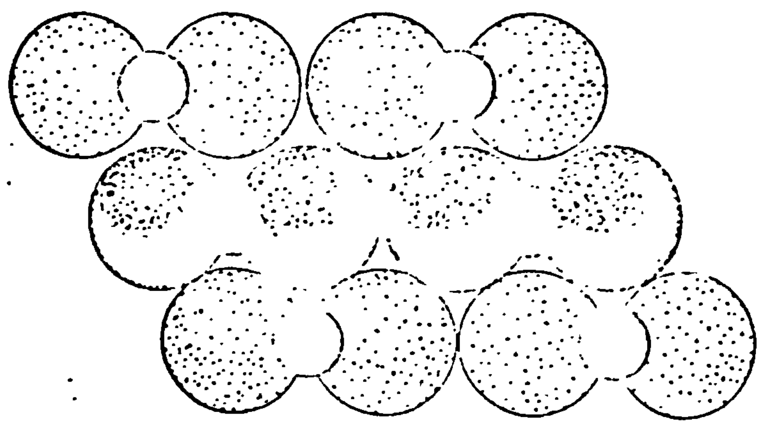

Fig. 1. An example of an RX_2 crystal.

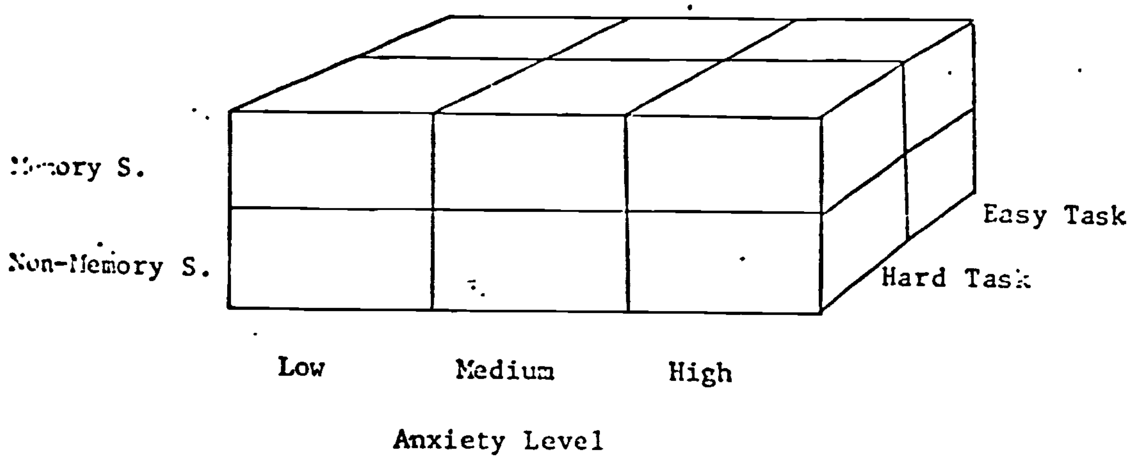

Fig. 2. Factorial Design of Independent Variables

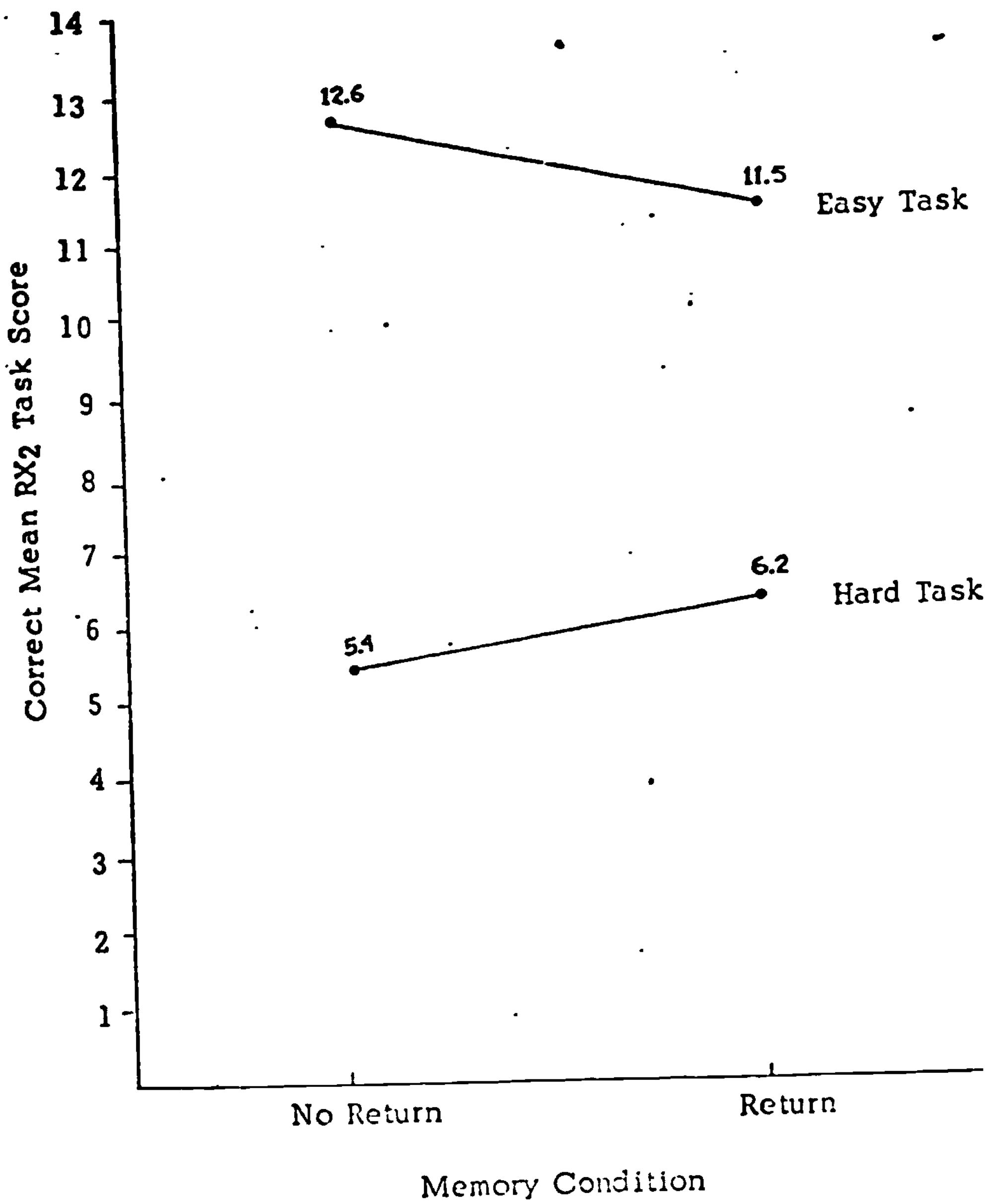

Fig. 3. Interaction between the memory support conditions and second task score, first RX_2 task score as covariate.

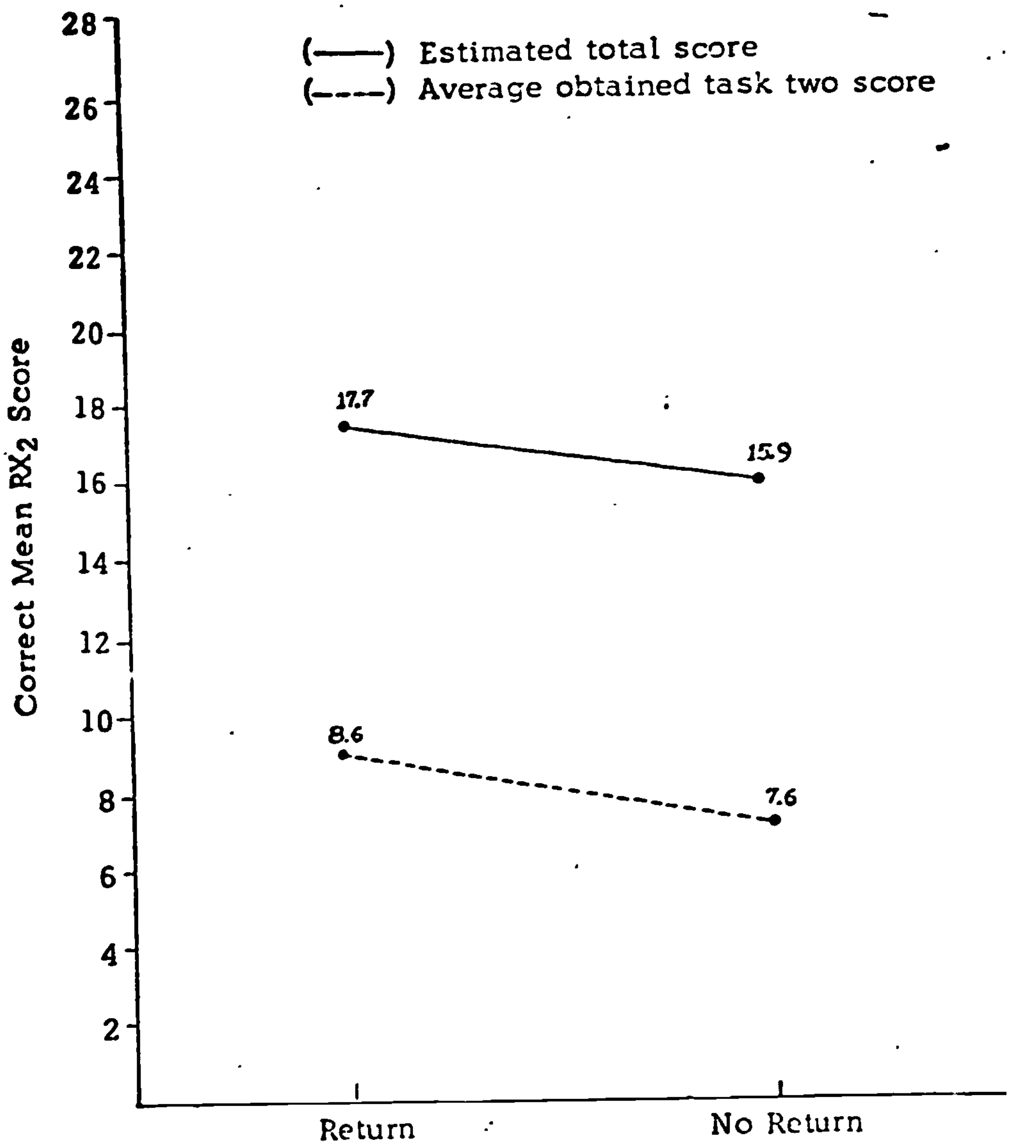

Fig. 4. The return condition of memory support and its effect on obtained average task two scores and total estimated scores with anxiety test two as covariate.

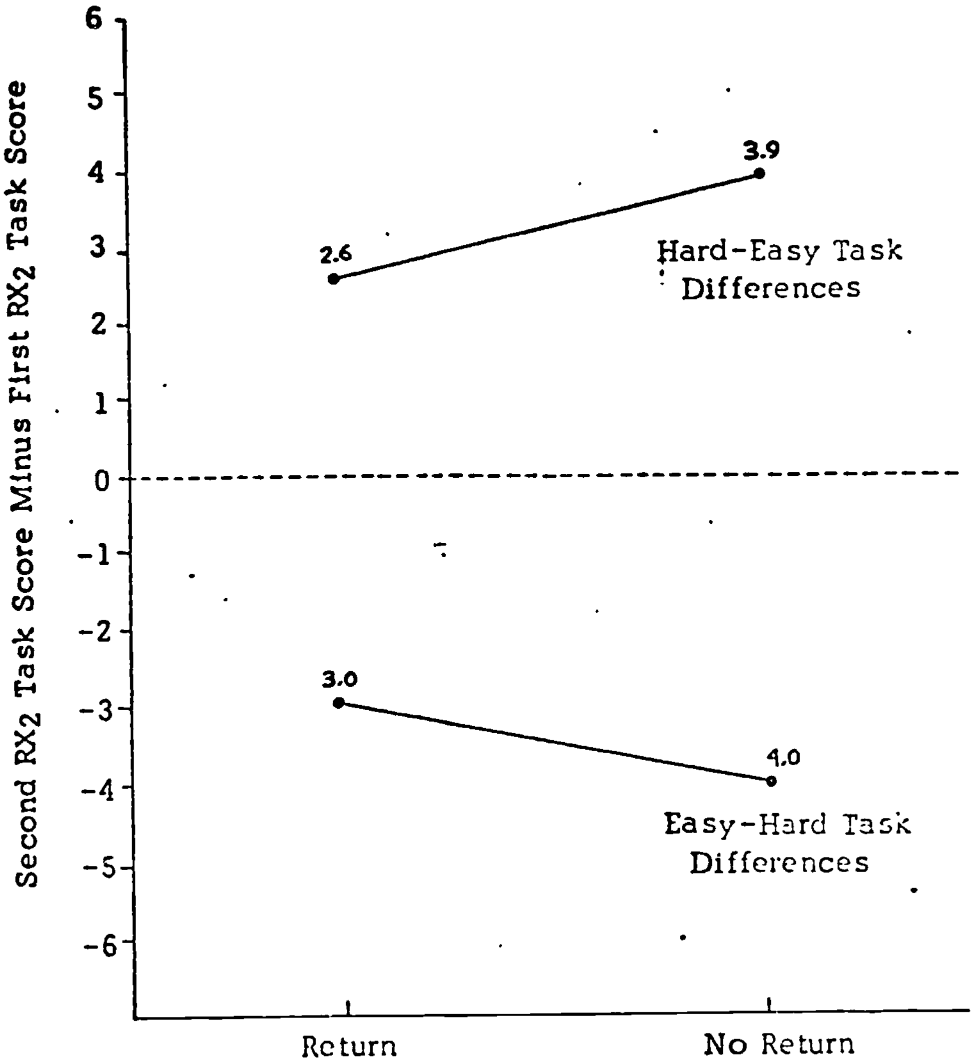

Fig. 5. Difference score; second RX_2 task score minus first RX_2 task score and memory support with anxiety test three as covariate.

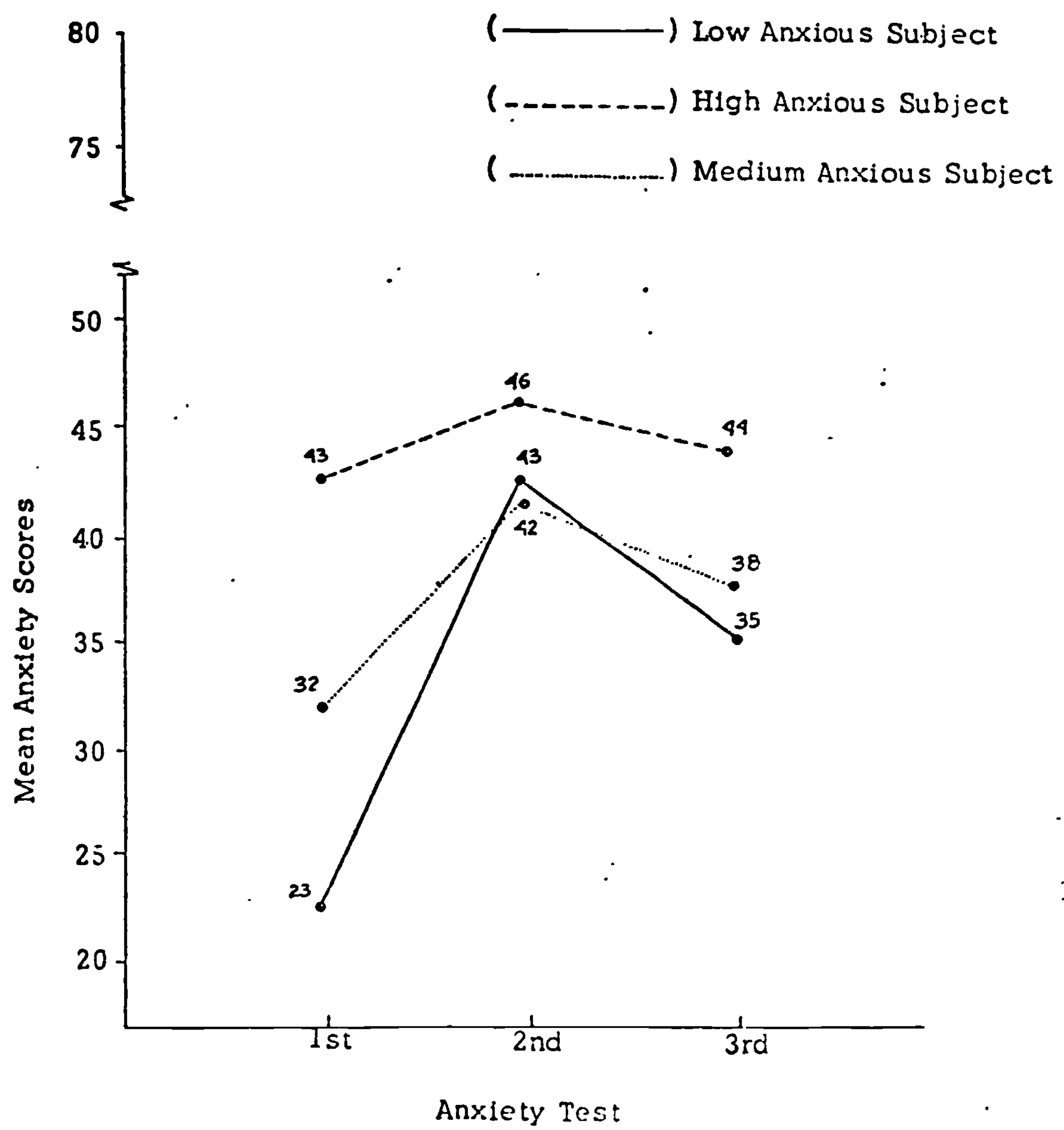

Fig. 6. Anxiety score difference for low, medium, and high initial anxiety score: for anxiety tests one, two, and three.

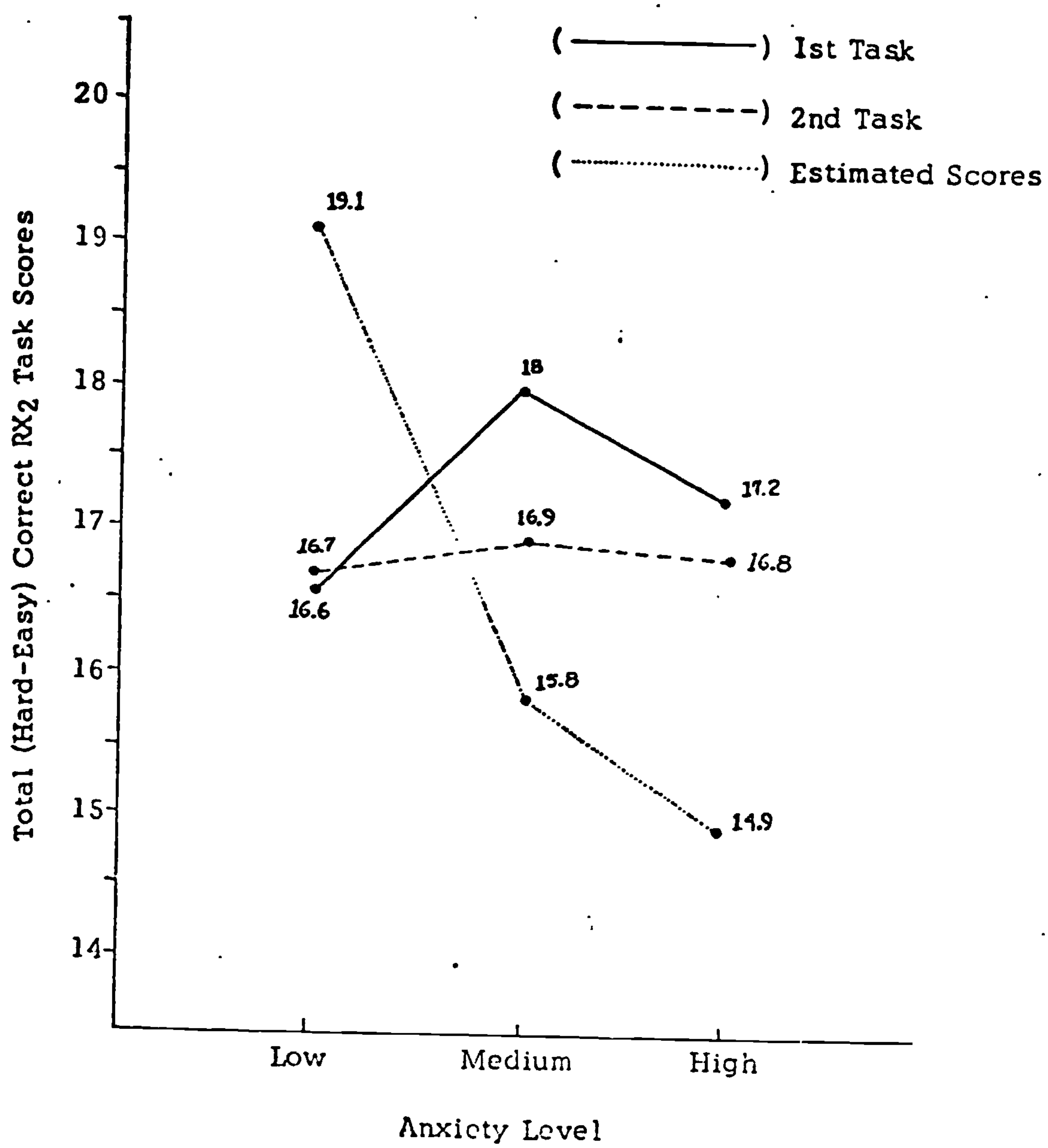

Fig. 7. Inverse relationship of self-report of competency and anxiety level, compared with first and second task scores.

References

Boutwell, R. C., Black, H. B., & Tennyson, R. D. Memory monitoring as a function of anxiety level and task difficulty in concept acquisition. Submitted, Journal of Educational Psychology, 1972.

Boutwell, R. C., & Black, H. B. Validation of protocol analysis: Data collection using an old medium. Working Paper No. 30, Brigham Young University, 1972b.

Boutwell, R. C. & Tennyson, R. D. Effects of two levels of task performance on trait anxiety and state anxiety. Submitted, Journal of Personality and Social Psychology, 1972.

Child, I. L. Personality. Annual Review of Psychology, 1954, 5, 149-171.

Dunn, R. F. Anxiety and verbal concept learning. Journal of Experimental Psychology, 1968, 76, 286-290.

Munz, D. C. & Smouse, A. D. Interaction effects of item-difficulty sequence and achievement-anxiety reaction on academic performance. Journal of Educational Psychology, 1968, 59, 370-74.

Norman, Donald. Models of human memory. New York: Academic Press, 1968.

O'Neil, H. F., Spielberger, C. D., & Hansen, D. N. Effects of state anxiety and task difficulty on computer-assisted learning. Journal of Educational Psychology, 1969, 60, 343-50.

Ostle, B. Statistics in Research: Basic Concepts and Techniques for Research Workers. The Iowa State University Press, 1963.

Pilisuk, M. Anxiety, self-acceptance, and open-mindedness. Journal of Clinical Psychology, 1963, 19, 387-91.

Ramond, C. K. Anxiety and task as determiners of verbal performance. Journal of Experimental Psychology, 1953, 46, 120-24.

Reitman, W. R. Cognition and thought. New York: Wiley, 1965.

Rosenberg, M. The association between self-esteem and anxiety. Journal of Psychiatric Research, 1963, 1, 135-52.

Shiffrin, R. M. & Atkinson, R. C. Storage and retrieval processes in long-term memory, Psychological Review, 1969, 76, 179-93.

Sieber, J. E., Kameya, L. I., & Paulson, F. L. Effects of memory support on the problem-solving ability of text-anxious children. Journal of Educational Psychology, 1970, 61, 159-68.

Smouse, A. D. & Munz, D. C. The effects of anxiety and item difficulty sequence on achievement testing scores. Journal of Psychology, 1968, 68, 181-84.

Spence, K. W. A theory of emotionally based drive (D) and its relation to performance in simple learning situations. American Psychologist, 1958, 13, 131-41.

Spence, K. W., Farber, I. E., & McFann, H. H. The relationship of anxiety (drive) level to performance in competitional and non-competitional paired-associates learning. Journal of Experimental Psychology, 1956, 52, 296-305.

Spielberger, C. D., Gorsuch, R., & Luschene, R. The State-Trait Anxiety Inventory, Test Manual for Form X. Palo Alto, California: Consulting Psychologists Press, 1969.

Taylor, J. A. Drive theory and manifest anxiety. Psychology Bulletin, 1956, 53, 303-320.

Tennyson, R., & Boutwell, R. C. Instance probability analysis. Submitted, AV Communication Review, 1972.

Tennyson, R., & Woolley, R. The effects of interaction of anxiety with performance on two levels of task difficulty. Journal of Educational Psychology, 1972, in press.

Tulving, E., & Madigan, S. Memory and verbal learning. Annual Review of Psychology, 1970, 21, 437-484.

Wolfgang, A., Pishkin, V., & Lundy, R. Anxiety and misinformation feedback in concept identification. Perceptual and Motor Skills, 1962, 14, 135-143.

Figure Captions

Figure

1 An Example of an RX_2 Crystal.

2 Factorial Design of Independent Variables.

3 Interaction between the memory support conditions and second task score, first RX_2 task score as covariate.

4 The return condition of memory support and its effect on obtained average task two scores and total estimated scores with anxiety test two as covariate.

5 Difference score; second RX_2 task score minus first RX_2 task score and memory support with anxiety test three as covariate.

6 Anxiety score difference for low, medium, and high initial anxiety score: for anxiety tests one, two, and three.

7 Inverse relationship of self-report of competency and anxiety level, compared with first and second task scores.