THE EFFECTS OF ANXIETY ON THE SHORT-TERM MEMORY
PROFICIENCY OF COLLEGE STUDENTS

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THE EFFECTS OF ANXIETY ON THE SHORT-TERM MEMORY PROFICIENCY OF COLLEGE STUDENTS

THESIS

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CHAPTER I

INTRODUCTION

Prior to 1940, a fair assessment of theorizing about memory seems to have been as follows: "Forgetting is produced by interference from the learning of habits which are incompatible to the habits previously learned" (16, p. 559). New developments since Ebbinghaus' studies with verbal materials, however, have introduced new variables and theories into memory studies. Several trends have been responsible for the renewed interest in memory, according to Melton (8, p. 3):

1. First, the revival of interest by learning theorists in assumptions made about characteristics of memory traces (engrams, bonds, associations, habit strengths) has stimulated controversy over previous memory theories. Estes, for instance, has questioned the validity of assumptions made by Hull and Spence that habit strength grows incrementally with repetition and proposed an all-or-none conception of learning.

2. Second, the research on proactive inhibition by Postman in 1961 and on the unlearning factor discovered by Barnes and Underwood in 1959, resulted in major revision of the interference theory of forgetting. For example, interference theory must incorporate concomitantly considerations of habit structure in individuals before new learning experiences and incompatibility or compatibility of new learning with the initial structure.

3. Third, the recent research on short-term memory as opposed to long-term memory has contributed new data on the information processing of man and computers.

The present study was designed to investigate some of the important variables in the third development. Specifically,
the question was asked: Does anxiety have an inhibitory effect on the short-term memory proficiency of low-anxious and high-anxious college students?

Review of the Literature

Until the last decade, most of the research on memory processes could be identified as studies of long-term memory. Whether the dependent variable was operationally defined as per cent savings, per cent recall, or per cent recognition, the retention interval was measured in minutes and often, hours and days (16). Three predominant theories emerged from the manipulation of long-term memory data: interference theory, unlearning, and the decay or stimulus trace theory.

The basic notion of interference as a cause of memory loss (forgetting) stemmed from the facts of retroactive inhibition. The general operational definition of retroactive inhibition may be diagrammed as follows (16, p. 554).

<table>
<thead>
<tr>
<th></th>
<th>Learn Task X</th>
<th>Learn Task Y</th>
<th>Recall Task X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Experimental Group</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 1--Operational definition of retroactive inhibition

If the retention of Task X is poorer for the experimental group than for the control group, retroactive inhibition is said to have occurred.
Representative of research in retroactive inhibition is a study conducted by Melton and Irwin (9) in 1940. The learning material consisted of serial lists of eighteen nonsense syllables having an average Glaze association value of 25 per cent. After a five-trial learning period subjects were given zero, five, ten, twenty, or forty trials on another list (interpolated list) of nonsense syllables, followed by relearning trials on the original lists. The mean number of correct responses, when compared to the zero condition of interpolated learning, decreased as a function of interpolated learning trials. It was concluded from the data that the conflicting associations between the original and interpolated lists were the result of repetition of letters in the two lists (16, p. 557).

Briggs (3) and others in 1954, however, argued that another interpretation of the Melton and Irwin experiment was possible. Perhaps while in the process of acquiring the interpolated associations, the original associations are unlearned or weakened. At recall, the original responses are not available, much like the extinction of a conditioned response.

Barnes and Underwood (2) in 1949 designed an experiment to reduce the ambiguity in the interpretation of forgetting. They used two lists following the A-B, A-D paradigm. The stimulus terms (A) were nonsense syllables and the response terms (B,D), adjectives. The first list was learned to a
criterion of one perfect trial. Independent groups of subjects were stopped at various points (after one, five, ten, or twenty trials) in learning the A-D list and given a recall test. Subjects were required to recall both response terms to any stimulus. The frequency with which the first list responses were produced decreased as the number of trials on the second list increased (2, p. 105). Since interference theory would predict both responses would be recalled, the data gave support to the idea that unlearning does occur in this particular paradigm.

A second modification of the original interference theory occurred after investigators initiated research on a new phenomenon called proactive inhibition. The general operational definition of proactive inhibition requires the following (16, p. 56):

<table>
<thead>
<tr>
<th></th>
<th>Learn Task X</th>
<th>Learn Task Y</th>
<th>Interval Retention</th>
<th>Recall Task Y</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Experimental Group</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Control Group</strong></td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Fig. 2--Operational definition of proactive inhibition

If recall is lower for the experimental group than for the control group, proactive inhibition has been demonstrated. If the decrement in performance is attributed to conflicting
associations, these associations must be learned prior to the learning of the task to be recalled.

A study by Youtz (17) provided evidence for interference effects due to proactive inhibition. He found that students who served in verbal learning experiments forgot 80 per cent of the items at recall after twenty-four hours (17, p. 565). When naive subjects were given a list comparable to the first Youtz list, retention was 80 per cent after twenty-four hours. Evidently, the associations previously learned by sophisticated subjects interfered with new learning.

The last major theory of long-term memory data followed the works of Thorndike, Hull, and Spence on the stimulus trace. At present it remains rather obscure and unformulated due to the physiological untestability of many of the derived hypotheses. The basic postulate of the theory is that memory (associations, bits) is stored in the central nervous system on hypothetical entities called stimulus traces. The qualities of these traces, which require a long period of time to consolidate, are inferred from manipulation of variables in verbal learning experiments.

An example of the questions asked about trace theory is (8, p. 5) "Should traces be given the characteristics of autonomous decay or are traces permanent structures?" Thorndike observed that in memory studies a person would recall 20 per cent of the material learned after twenty-four hours. In his "Law of Disuse" he speculated that unless material was
rehearsed, the trace for that event, thing, or action would
decay spontaneously as a function of time. Hull, however,
gave more recognition to the postulates of trace interference
from adjacent traces and to the strength of traces as a
function of repetition (8, p. 6).

In contrast to long-term memory studies are studies of
short-term memory in which the retention interval is measured
in seconds. Short-term memory, also called running memory,
sequential memory, immediate memory, and memory span, identifies
an area of research initiated by interest in the electronic
storage systems of computers. In order to develop maximum
efficiency in computer systems, it was essential that
technicians and psychologists study the processes and inde-
dependent variables involved in man's immediate or short-term
decisions. The work on short-term memory has brought with it
certain theories which confound those for long-term memory
(16).

Two theories for short-term memory are popular at present
(4). The trace comparison theory states that the degree of for-
getting is a function of the relative strengths of a stored
trace as compared with previously stored traces at the time
of recall. Acid bath theory states that interfering stimuli
interact with the trace spontaneously during the retention interval
to weaken its strength as a stored item. Interference effects
can be eliminated when full capacity for rehearsal of stored
traces is available (4, p. 865).
Many experiments have focused on these theoretical issues. Posner and Konuk (14) in 1966 tested the recall by subjects of lists of meaningless letter trigrams such as ZRF. Each trigram was followed by a ten-second retention interval and a recall period. The lists were presented so that each trigram occurred equally often at each serial position in the lists. During the retention intervals, sequences of letters varying in length and similarity to the memory material were presented auditorially. It was found that the per cent recall for each trigram was a significant function of the number and similarity of interpolated letter sequences in the retention interval. Since trace comparison theory would predict no such difference, it was concluded that the data supported the acid bath theory of interference effects during the retention interval.

Newell (12) in 1968 used an acoustic disruption during a retention interval to alter the short-term memory of forty-six ten-and eleven-year-old children (12, p. 63). Children who heard a disruptive stimulus during a five-second retention interval remembered fewer sets of five consonant sequences than those whose short-term memory was tested under normal conditions. Newell's data supported the theory that the source of interference in short-term memory is in the retention interval rather than at the time of recall.

Confronted with a dichotomy of memory studies into short-term memory and long-term memory, theoretically oriented
investigators began an intensive investigation of the continuity or discontinuity in the two sets of theories. The basic question was (8) "Is memory storage a single process or a dual process?"

Melton (8) in 1963 reviewed the major research supporting a duplex theory of memory. Using data gathered by Broadbent in 1958 and Hebb in 1963, he reduced the arguments for discontinuity to three major contentions (8, p. 10).

1. Short-term memory involves transient activity, and long-term memory involves permanent traces.
2. Short-term memory involves autonomous decay, while long-term memory involves irreversible non-decaying traces.
3. Short-term memory has a fixed capacity that is subject to overload, while long-term memory is infinitely expandable with failure to retrieve attributed to incompleteness of cue or to interference from previously learned associations.

Theorists in agreement with the continuity principle argue, however, that recent evidence either does not support the contentions of differences in the expected theoretical directions or lends support to interpretation of short-term memory data in terms of interference factors.

Peterson and Peterson (13) in 1958 determined the recall of single trigrams presented auditorially, such as VJR, after intervals of three, six, nine, twelve, and eighteen seconds (13, p. 193). Counting backwards by threes and fours from a three-digit number provided a rehearsal-preventing task. The retention data followed the typical Ebbinghaus curve found in long-term memory, but the per cent of forgetting was
appreciable after only a three-second retention interval. The authors interpreted this rapid deterioration as being inconsistent with any theory of trace decay (13).

Murdock (11) in 1962 duplicated Peterson's experiment but used single common words drawn from the frequent ones in Thorndike-Lorge word lists and triads (three unrelated common words) as short-term memory material (11, p. 619). He found that 10 per cent of the single words were forgotten after three seconds, and that word triads acted like three-consonant trigrams in short-term memory retention tasks. He concluded that the data suggested (11, p. 624):

1. The critical determinant of the slope of short-term memory retention curves is a function of the number of Millerian "chunks" in the memory units.
2. Other things equal, the rate of forgetting is a function of intra-unit interference between encoded "chunks" in an item, rather than the number of physical elements (letters, words, or information units).

The second supposition suggests a short-term memory counterpart to long-term memory interference effects.

Melton (8), taking the continuity position, replicated the Murdock study, but used one-to five-letter consonant units. As previously indicated, he found a dramatic increase in slope of the short-term memory curve as a function of encoded "chunks" in the units. This finding, supplemented by evidence of a high-frequency recall for single consonant units after a thirty-two second interval filled with overloading activities (counting backwards), argued against
autonomous decay and fixed capacity being major factors in short-term memory tasks. Of greater importance, he made two observations which would be predicted from intra-unit interference factors (8, p. 16). First, the single consonant units had the greatest recall across all intervals. Second, as the size of consonant units increased, fewer first letters were recalled for all retention intervals. The data supported the continuity position of interference effects in short-term memory.

In Melton's study, some one-consonant units were forgotten. To explain the phenomenon, Melton suggested that a form of retroactive inhibition was operating as a result of disrupting stimuli (counting backwards) to interfere with recall (8). The experiment was not designed, however, to factor out retroactive inhibition interactions with intra-unit interference.

Experiments conducted recently show that both retroactive inhibition and proactive inhibition forms of interference may be operating in short-term memory.

Keppel and Underwood (7) in 1962 found evidence for proactive inhibition effects in short-term memory. Six lists of three-consonant trigrams each were presented ordinally to subjects, using three- and eighteen-second retention intervals. The per cent frequency of correct recall of trigrams declined over the lists as a function of the ordinal position of the list. The sixth list, as would be expected from proactive
inhibition effects, had the greatest decline in recall (7, p. 160).

Arguments for discontinuity of the short-term memory and long-term memory systems are still supported. Scott, Whimbey, and Casey (15), for instance, investigated the effects of a previously learned item (long-term memory) and a newly learned item (short-term memory) on the growth of within-list proactive inhibition. The long-term memory and short-term memory items were randomly selected consonant trigrams. Fifteen trigrams chosen from Witmer's association value list were the stimuli on the lists. It was shown that an item in long-term memory has a different effect on within-list proactive inhibition than does an item in short-term memory. The number of trigrams recalled correctly in the list after a long-term memory item was presented was significantly higher (p < .01) than the number recalled after a short-term memory item was introduced into the list. Apparently, the long-term memory items did not generate proactive inhibition, supporting a dual theory of memory (15, p. 56).

Many investigators, aware of the theoretical issues between short-term memory and long-term memory, chose a different approach to these phenomena. These investigators have been more concerned with the effects of independent variables on memory rather than in supporting or disallowing theoretical concepts.
Baddeley (1), for instance, in 1968 used the digit probe technique devised by Waugh and Norman to investigate short-term memory. In this technique, the subject is presented with a sequence of digits followed by a probe, a repetition of one of the digits, at which point he attempts to say which digit followed the probe. Subjects listened to sequences of seven digits followed by a one second pause and zero, two, four, eight, or sixteen letters to be copied down as a rehearsal preventing task. For the experimenters, the most significant finding was that forgetting was a function of intervening items in the retention intervals regardless of whether these were digits to be retained or letters to be copied for rehearsal prevention (1, p. 46).

Holmes and Trolley (6) in 1967 found that massive cortical and subcortical shock disrupts recent memory (short-term memory) but not long-term memory (6, p. 56). The data indicated, however, that anxiety generated by anticipated acoustic disruption had a greater effect on short-term memory than higher levels of electroconvulsive shock.

The present study is concerned with these relationships between a certain affect called anxiety and short-term memory. Ehrlick (5, p. 623) in 1966 stated the problem succinctly: "The relationship between affects and other psychological processes such as learning and memory requires clarification."

In retrospect, three types of studies have been devised to study the effects of anxiety on short-term memory (4).
Type I experiments held the stimulus material constant and varied the experimental groups. Digits or nonsense syllables were the dependent measures of memory performance compared between anxious-nonanxious groups. Criticisms of this method were that clinically nonsense or meaningless material was not likely to arouse anxiety. Type II studies induced anxiety through instructions given to the experimental group, prior to testing, and by the use of observers and signaling apparatus during testing. A serious criticism of such research was that the control groups were not subjected to the same external distractions and instructions. Type III studies varied the stimulus material and held groups constant. Failure to control relevant variables usually confounded the results. All three types of studies, however, indicated that performance is inhibited on short-term memory tasks as a function of anxiety.

In a major study, Bush (4) attempted to overcome previous methodological problems. He introduced a fourth type design in which both stimulus materials and experimental groups were varied (4, p. 866). The memory materials were three sets of ego-threatening pictures which had been loaded for most-least anxiety provoking in a pilot study. The Welsh Anxiety Scale of the Minnesota Multiphasic Personality Inventory was used to divide students into anxious-nonanxious normals. Perceptual distortion was the criterion for anxiety. The results indicated that only after the initial recall interval did the
anxious group recall less than the normals, suggesting the effects of anxiety provoking material on performance dissipate with time. An obvious inadequacy of the design, however, was a variable short-term memory retention interval for each picture, since the recall period followed a set of pictures en toto, rather than each individual picture. The objectivity of perceptual distortion as a criterion measure of anxiety was also questioned.

Bush's results were more or less consistent with those obtained by Ehrlick (5), who worked from a more theoretical framework. She devised two experiments based upon Blum's model of the mind (5, p. 622). In the first she explored the components of pleasure and anxiety in a memory span test using hypnotically controlled students. "Pleasure" or "anxiety" was induced verbally. She found memory span decreased monotonically as a function of anxiety level. Pleasure produced less consistent results.

In experiment two the relationship between onset of affect and memory span was studied. Anxiety was again induced verbally under hypnotic suggestion, but additional instructions were given preceding the experiment to elicit anxiety. She found anxiety produced a significant decrement (p < .01) in performance (recall) at all levels of onset. It was concluded by the experimenter that anxiety is characterized primarily by inhibitory features which interfere with the coding, consolidation, and retrieval of memory traces.
However, there was some question of the objectivity and adequacy of hypnotic suggestion as a criterion of anxiety in Ehrlick's study, since some subjects appeared to be in a "deeper" or more suggestible state than other subjects.

**Statement of Problem**

Based on the review of literature, it has been demonstrated that anxiety has some detrimental effects on the short-term memory functions of the college student. In order to improve the experimental methodology, the present study combined Type I and Type II studies of short-term memory as a function of anxiety. The two were combined so that the major criticisms in each study were controlled. First, the same pre-experimental instructions were given to both experimental groups. Second, the same anxiety provoking instructions were presented to each group. Under these conditions it was proposed that a low-anxious college population would remember more digit sequences than would a high-anxious college population on a short-term memory task.

There was a second area of interest in the same design. The question asked was: "What relationship, if any, is there between anxiety levels and short-term memory retention intervals?" Based on previous short-term memory data, it was suggested that a significant decrement in performance would occur for all levels of anxiety, as a function of increased retention interval. The greater the retention interval, the fewer digit sequences that will be remembered.
Statement of Hypothesis

The following hypotheses were formulated:

1. A group of low-anxious students will remember significantly more digit sequences on a short-term memory task than will a group of high-anxious students.

2. As retention intervals are increased, both low and high-anxious students will forget a significant number of digit sequences.
CHAPTER BIBLIOGRAPHY


CHAPTER II

METHOD

Subjects

The subjects for the experiment were seventy-two male and female students in introductory psychology classes at North Texas State University. The subjects were chosen from a pool of one hundred and twenty-five students, based on their scores on the IPAT Anxiety Scale Questionnaire. In the selected sample, thirty-three subjects were male and thirty-nine subjects were female. The mean age was nineteen years for all subjects. Selection was made so that the number of subjects in experimental groups would be equal.

Test Validity

The Handbook for the IPAT Anxiety Scale Questionnaire provided substantial evidence for the validity of this test as a measure of anxiety (1). The most pertinent question asked by the test authors in relation to the present study was, (1, p. 7) "Does this test measure anxiety as it is commonly conceived of and evaluated by extra-test means, especially clinical ratings?"

Two examples of external concrete validity were cited. First, in two separate studies by Cattell and Scheier (1) the scores on the factor measured by the Scale were correlated.
directly with psychiatric evaluations of anxiety on the same people (1). The sample of subjects included a representative number of college students. The correlation between clinical consensus and the IPAT Anxiety Scale scores ranged from +.60 to +.70. Second, the test scores on the IPAT Anxiety Scale distinguished very sharply between normals and high anxiety cases (anxiety hysterics, anxiety neurotics). A statistical comparison was made between the IPAT Anxiety Scale scores of 795 normals (482 men and 313 women in the average age range) and 174 anxiety cases in an outpatient clinic (1, p. 8). On a standard ten (or sten) scale running from 1 to 10, the normal average anxiety level is fixed at 5.5; these 174 anxiety cases averaged 8.1 stens. Their superiority reached statistical significance at the one-tenth of 1 per cent level.

Task and Procedure

In a preliminary phase of the experiment thirty-six subjects were placed into a low-anxious group and thirty-six subjects into a high-anxious group. The operational definition of high-anxious placement was a score greater than +1 standard deviation above the mean for college students tabulated in the IPAT Anxiety Scale Handbook. Low-anxious placement was contingent on a score between +1 standard deviation and -1 standard deviation from the mean for college students tabulated in the IPAT Anxiety Scale Handbook. The subjects in each group were then assigned, on a random basis, to three subgroups corresponding to retention intervals of
five, ten, and fifteen seconds, such that each subgroup was equal (N=12). All subjects were instructed that at some later date they would be asked to complete a task involving variables related to intelligence.

In the second phase, each subject individually was given a single short-term memory task to complete corresponding to his or her retention interval placement. The short-term memory task was presented on a recording tape using a General Electric portable tape recorder. The tape was composed of twelve three-digit sequences selected from a table of random numbers. Three tapes were used for the experiment, equivalent in structure except for the five, ten, or fifteen second retention interval following each digit sequence. A subject who was assigned to a five second interval, for example, was presented with the same digit sequence as a subject assigned to a fifteen second interval; the difference in tapes remained only in terms of the retention interval following each digit sequence. Each subject served under only one condition (one retention interval). The instructions given to all subjects on the tapes were:

In the following tape you will hear some digit sequences. Followed by each digit sequence you will hear a number. Repeat this number and count backwards by threes until you hear the word recall. For instance, if you hear three...six...nine (ninety-six), you would say ninety-six, ninety-three, ninety, et cetera, until the word recall is audible. After the word recall you will have a few seconds to write down the previous digit sequence on your recall record. The previous digit sequence in this example is three...six...nine. Do you have any questions on the instructions?...Begin.
Preceding the task, the following instructions were given to elicit anxiety:

This is an experiment involving variables related to intelligence. Specifically we are interested in determining whether certain verbal instruments can predict if a person is achieving or underachieving in his or her academic pursuits. Since your performance on this task will be compared to that of your classmates, it is to your advantage not to discuss the contents of this task with them until all the data has been collected. Please do your best since inconsistencies will alter your placement.

The instructions presented duplicate those used by Ehrlick in her study of short-term memory and anxiety (2, p. 622). In a pilot study she found students performed significantly better (p < .05) on meaningless verbal tasks when ego-involved instructions were omitted.

Analysis of Data

The sum of correct responses for each subject was tabulated as the dependent measure. Data for all subjects were placed in a two-by-three factorial design for analysis. An analysis of variance for a two-by-three design was computed to test the two hypotheses. The level of significance was set at .05.
CHAPTER BIBLIOGRAPHY


CHAPTER III

RESULTS AND DISCUSSION

The results of the analysis of variance are presented in Table I.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>P#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxiety Level</td>
<td>16.05</td>
<td>1</td>
<td>16.05</td>
<td>3.504</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Retention Interval</td>
<td>6.58</td>
<td>2</td>
<td>3.29</td>
<td>.718</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Interaction</td>
<td>13.37</td>
<td>2</td>
<td>6.69</td>
<td>1.460</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Within Groups</td>
<td>302.00</td>
<td>66</td>
<td>4.58</td>
<td>...</td>
<td></td>
</tr>
</tbody>
</table>

*Probabilities are for a one-tailed test of significance.

The two proposed hypotheses are not supported by the data. The differences in performance on the short-term memory task between low and high-anxious subjects are not significant (p > .05). The retention interval differences are also not significant (p > .05).

Trends are observed in the hypothesized directions, however, when the mean recalls for the main effects of anxiety
level and retention interval are computed. As shown in Table II, the low anxious students do remember, on the average, one more digit sequence than the high-anxious students.

**TABLE II**

**COMPARISON OF MEAN RECALL FOR ANXIETY LEVELS**

<table>
<thead>
<tr>
<th>Group</th>
<th>Number</th>
<th>Mean Recall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-Anxiety</td>
<td>36</td>
<td>5.47</td>
</tr>
<tr>
<td>High-Anxiety</td>
<td>36</td>
<td>4.53</td>
</tr>
</tbody>
</table>

The average number of digit sequences remembered for both anxiety levels does decrease monotonically as a function of the retention interval. The recall means are shown in Table III.

**TABLE III**

**COMPARISON OF MEAN RECALL FOR RETENTION INTERVALS**

<table>
<thead>
<tr>
<th>Retention Interval in Seconds</th>
<th>Number</th>
<th>Mean Recall</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>24</td>
<td>5.42</td>
</tr>
<tr>
<td>10</td>
<td>24</td>
<td>4.88</td>
</tr>
<tr>
<td>15</td>
<td>24</td>
<td>4.71</td>
</tr>
</tbody>
</table>

Although the tested hypotheses are not confirmed, two observations suggest further research in this area would be fruitful if certain design problems were eliminated.
First, as illustrated in Figure 3, there is a tendency towards interaction between retention intervals and anxiety levels. This suggests that the differences in performances for anxiety levels may depend on the difficulty of the short-term memory task. The difficult tasks in the present study are defined as those tapes with the longer retention intervals (ten and fifteen seconds). On an easy task the high-anxious subjects remember more sequences than the low-anxious ones, while on more difficult tasks the reverse would be true.

![Fig. 3--Interaction of anxiety levels and retention intervals.](image)

This observation is consistent with the results of long-term memory studies in verbal learning as a function of anxiety. Wittrock and Husek (3) in 1962, for instance, found a significant interaction between anxiety levels in students...
and the complexity of verbal material for retention. Low-anxious students remembered more lines of complex Buddhism after twenty-four hours than did high-anxious students. The high-anxious students, however, remembered more lines of simple Buddhism than did the low-anxious students after the same retention interval.

Second, as shown in Figure 4, the per cent recall curve for all subjects as a function of digit sequence position resembles the Ebbinghaus long-term memory curve for serial learning.

Fig. 4--Per cent recall for all groups (N=72) as a function of digit sequence position.

Digit sequences presented first are the easiest to remember, the last sequences the next easiest, and the middle sequences
are the most difficult to remember. This second observation suggests that short-term memory functions, measured in similar experimental designs will support the continuity of memory processes.

On basis of the two observations noted above, the relation of the present research to theoretical controversy over memory processes should be clarified. Two points of interest are relevant to this discussion.

First, there is no evidence in the present study that anxiety differentiates between short-term memory and long-term memory functions. The tendency towards interaction between anxiety levels and task difficulty, for instance, argues for continuity between the two systems when these variables are manipulated. This point suggests that further research on the effects of anxiety on memory systems should concentrate on factoring out the significant variables in the studies, rather than in resolving theoretical controversies.

Second, the present study supports those investigators who have been concerned with the effects of independent variables on memory, rather than with postulates in theories. Melton, (2) in a previous study, found that the recall curve for short-term memory items diverged from the classical Ebbinghaus curve. This is inconsistent with the observation made in the present study, in which the recall curve for short-term memory items resembles the Ebbinghaus curve. Both studies were similar in design except for a variation in the
timing for recall periods. Similar discrepancies were mentioned in the review of the literature where support for a continuity or discontinuity position was the function of unique variables in a defined design. The point suggests that the purported differences in short-term memory and long-term memory processes may be contrived products of experimental methodology. At present it appears unrealistic to conceive of any memory theory which would predict validly, when the complex interactions of so many independent variables have not been determined.

It was notable that numerous methodological problems may have confounded the results of the present study. Three subject variables and one task variable were obtained. First, because of time limitations, there were a few subjects who were given the short-term memory task in pairs. These subjects appeared to be more at ease and less restless in the experimental situation than subjects appearing individually. Apparently, the partner provided some security in the stressful task. It is questionable, therefore, whether the anxiety provoking instructions elicited any anxiety in these subjects.

Second, many subjects who scored an extreme score in the operationally defined groups on the IPAT Anxiety Scale were only one or two points from reclassification. For example, subjects who had a raw score of thirty-nine were classified as low-anxious students, while subjects with a raw score of forty were classified as high-anxious subjects.
It appeared that a more sensitive instrument and or definition of high and low-anxiety was needed to differentiate the desired population.

Third, the two groups were not matched on achievement motivation or on any intellectual variable. After an inspection of grades, it was noted that 90 per cent of the high-anxious males or females were A or B students. The low-anxious group, however, was composed mostly of average students. The fact that high-anxious students were good students may have introduced differential interactions between intellectual variables, anxiety, and short-term memory performance.

Fourth, no device was used to pace the subjects' counting backwards on the rehearsal prevention task. All subjects were instructed to count backwards by threes until the recall signal was audible. It was observed that subjects with the difficult short-term memory tasks (ten or fifteen second interval) reduced their counting speed in the retention interval as the time for the recall signal approached. As a result, the average number of two-digit numbers counted backwards for rehearsal prevention by the subjects with the difficult tasks, approached the number counted by the subjects with the easy tasks (five second interval). Since the number of intervening items in the retention interval has been shown to be a significant factor in short-term memory studies; the proposed performance decrement as a function of increased retention time may have been confounded by surreptitious sequence rehearsal and or reduced intra-list interference (1, p. 46).
CHAPTER BIBLIOGRAPHY


CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The present study investigated the effects of anxiety levels and retention intervals on the short-term memory performance of college students. Two hypotheses were formulated. First, low-anxious students would remember significantly more digit sequences than would high-anxious students. Second, all subjects would remember significantly fewer digit sequences as a function of increased retention interval.

The subjects used were seventy-two male and female introductory psychology students attending classes at North Texas State University. Students were assigned to either a high-anxiety or a low-anxiety group contingent on their scores on the IPAT Anxiety Scale. Selection was made so that both groups had equal numbers of males and females (N=36). The subjects in each group were then assigned on a random basis to three subgroups (N=12) corresponding to retention intervals of five, ten, and fifteen seconds. Each student was given a short-term memory task composed of twelve three-digit sequences corresponding to his or her retention interval placement. The task was presented so that previous methodological problems
in short-term memory anxiety studies were controlled: namely, equal instructions to both groups and presentation of the task under anxiety provoking conditions. The number of correctly recalled digit sequences for each subject was the basic data for analysis. Data was placed in a two by three factorial design for statistical testing by analysis of

The data did not support the first or the second proposed hypotheses at the desired level of significance (p < .05). Trends were observed in the hypothesized directions, however, when the means for the main effects of anxiety level and retention interval were calculated. Several methodological problems and two observations in particular were found which demonstrated the necessity for further, more highly controlled, research in this area.

Conclusions

Three conclusions are formulated from the results of this research:

1. First, anxiety as defined by the IPAT Anxiety Scale does not significantly interfere with the short-term memory of a high-anxious college population when compared to a low-anxious college population.

2. Second, increasing the retention intervals on the short-term memory tasks for the defined anxiety groups does not significantly affect their short-term memory.
3. Third, the numerous methodological problems in the design demonstrate a need for further, more highly controlled research concerning the hypotheses.

Recommendations

There are several recommendations for further study that are apparent, due to the design inadequacies and results of this research. One suggestion would be a replication of this study but using three procedural alterations. First, all subjects should be tested individually in a room void of distractions and companionship. Second, a metronome or timing light should be used to pace the subjects' counting on the rehearsal preventing task. Third, the two anxiety groups should be matched on some standardized intelligence test.

A second suggestion is that a similar design be replicated but with a new operational definition of high or low anxiety. The IPAT Anxiety Scale is a short questionnaire, usually used in conjunction with other test batteries and or clinical observations. Perhaps a more comprehensive multi-scaled questionnaire such as the Minnesota Multiphasic Personality Inventory or the Objective-Analytic (O-A) Anxiety Battery would differentiate anxiety levels more precisely.
BIBLIOGRAPHY

Books


Articles


