THE EFFECT OF ANXIETY LEVEL UPON STIMULUS GENERALIZATION IN PAIRED-ASSOCIATE LEARNING AND RECOGNITION MEMORY

By

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TABLE OF CONTENTS

TABLE OF TABLES

TABLE OF FIGURES

Figure Page

CHAPTER I

INTRODUCTION

Historical Background

Since Freud (7) asserted several decades ago that anxiety was the "fundamental phenomenon and central problem of the neuroses," applied psychoanalysis has proceeded to substantiate this proposition. The importance of anxiety is, however, not only stressed in more orthodox psychoanalytic theory and its many variants but in other theories of personality as well. Typically the concept is used to account for the development and maintainance of a variety of symptoms, but it is also used more specifically to refer to particular vasomotor disturbances or behavioral signs of tension. Thus, clinical anxiety is either a hypothetical construct (or implicit process) that is assumed to determine certain types of overt behavioral adjustments or a term applied to a particular behavioral syndrome. In most psychoanalytic writings it is used in one or both ways, often without making this distinction clear.

Recently the concept of anxiety has entered into the theories of learning with a more precise meaning. It is

defined by such theorists as Mowrer (18), and Miller and Dollard (16) as an implicit response conditioned to previously neutral cues which have been associated with noxious stimulation. Mowrer (18) first proposed this formulation by stating that anxiety is "the conditioned form of the pain reaction." Miller and Dollard (16) have developed this general concept of anxiety by proposing that anxiety has the functional properties of both a stimulus and a response. In brief, they assume (1) that fear (or anxiety) obeys the same laws as do external responses and (2) that it has the same drive and cue properties as strong external stimuli. It is thus a construct that is defined in terms of antecedent and present stimulus conditions. Defined in this way, anxiety is assumed to have at least two of the functional properties of primary drives: its reduction should act to strengthen responses that precede its reduction and it should intensify those response tendencies that are present during its period of evocation. Evidence that the experimental definition of anxiety yields a state which exhibits both the reinforcing and energizing properties of an acquired drive has come from recent experiments with lower animals.

Miller (15) provided some support for this view when he showed that fear of a white box in which albino rats had previously been shocked would motivate so-called random

behavior and, when the fear is reduced through escape from the white box, it serves as a reinforcing state of affairs for the learning of the immediately preceding response (rotating a wheel or pressing a bar). Mowrer has shown similar evidence of the reinforcing properties of anxiety-reduction (19). Also in an experiment by Brown and Jacobs (3), it was found that rats learned to jump a hurdle when this response was followed by termination of a light and a buzzer that had previously been presented with shock. Farber (6) also showed that anxiety-reduction was reinforcing in an experiment in which the fixation of certain responses was accounted for in terms of the reinforcing effects of escaping from stimuli previously associated with shock. Several studies have shown the energizing and other motivational properties of anxiety (1, 12, 22, 26).

There is admittedly a difference between the clinical concept of anxiety and the experimental concept of anxiety developed above when the defining operations of the two concepts are compared. But, as Rosenbaum (22) and others (17, 23) have explicitly or implicitly indicated, there is some justification for the belief that there are important similarities in the functional properties of these two hypothetical states. Recent experimental investigations

with human subjects bear out this assumption. In one study (25), Taylor found that college students who scored high on a scale designed to measure manifest anxiety were consistently superior in the amount of conditioning of the eyelid blinking response to students who scored low on the scale, the differences between the groups being highly significant statistically. Later studies by Spence and Taylor (23) and Hilgard (9) using similar procedures tend to confirm this finding. Welch and Kubis (27), using a clinical group of hospitalized subjects manifesting psychiatric symptoms of anxiety, found that these subjects conditioned the PGR response much more rapidly than did non-anxious subjects with whom they were matched.

In addition to the above evidence that both clinically-diagnosed and experimentally-induced anxiety act as motivational determinants of behavior, a recent study by Rosenbaum (22) points up the desirability of further investigation of the relationship between the two states and other variables of behavior. Positing the functional similarity of the two states he set out to demonstrate the effects of both types of anxiety upon stimulus generalization. Following the Hull-Spence (11, 24) formulation that conceives the strength of response tendencies to be a multiplicative function of habit strength and general drive level of the

responding organism, he assumed that the drive value operating at the time of occurrence of a conditioned response is determined not only by the relevant drive (i.e., the one that is reduced by the response under consideration), but also by the aggregate strength of all other primary and secondary drives operative at the moment. He also assumed that an increase in the drive state of the organism should strengthen the response tendency not only to the conditioned stimulus but also to other stimuli differing from it along a given dimension. He then hypothesized that, if an anxiety state, defined either in terms of clinical observation or experimental operations, has similar energizing properties of a drive, it should also have other similar properties. More specifically he posited that it should have the effect of raising the stimulus generalization gradient. When he subjected these hypotheses to experimental test, he found that increases in experimentally induced anxiety (buzzer, mild shock, strong shock) did raise the stimulus generalization gradients of response amplitude in accordance with the predictions of Hull (11). However, he did not find that subjects high and low in anxiety (as judged by psychiatric ratings of a clinical group or scores on the Taylor anxiety scale of a college population) differed in stimulus generalization except

under conditions of high experimental anxiety. Under those conditions the clinically anxious subjects showed the predicted increase in stimulus generalization over the low-anxiety subjects. He interpreted these findings to mean that anxiety is a state variable in the organism which is only activated when certain noxious cues are present. This interpretation does not seem unwarranted. However, the important things to note here are his findings that an increase in experimental anxiety raises the generalization gradient and that clinical anxiety, when an operative variable, produces a similar effect. These results add further support to the assumption of certain functional similarities between the two anxiety concepts.

Rosenbaum reported another interesting finding. According to the deductions of Hull's theoretical system increased drive should not only raise but also steepen the gradient of response amplitude. Rosenbaum did not find support for this hypothesis. Instead there was a distinct tendency for the gradient to rise and flatten with increases in experimental and clinical anxiety under strong shock conditions. Rosenbaum explained this in terms of the artificial ceiling imposed upon the measure of response amplitude used in this experiment. He posited that whenever

the measure of response strength employed approaches its maximum (100 percent) for the conditioned response, any further increments in drive will contribute to the strength of responses to generalized stimuli, but cannot further elevate the strength of the conditioned response. There is some basis, in terms of the physical limitations imposed upon the response measure by the conditions of his experiment, for such an interpretation.

However, there is also some basis for an alternative explanation if we consider more than merely the effect of increase in drive on reaction tendency to the original and altered stimuli. Another characteristic of elevated drive which should be considered is the presence of response tendencies associated with the drive-stimulus. Within the framework of Hull's theoretical system, every drive is assumed to be associated with a drive-stimulus to which responses characteristic of the drive may be connected with varying degrees of reaction potential. These conditioned or unconditioned response tendencies are present whenever the drive-stimulus is present and their strength is dependent upon the intensity of the drive. It is assumed here that their presence will facilitate the acquisition of responses compatible with them and interfere

with the learning of responses not compatible with them. A similar effect should obtain in a situation in which the strength of a conditioned response to stimuli differing from the originally conditioned stimulus along a similarity dimension is tested. If the response produced through generalization is compatible with the drive-produced response tendencies, it should show some augmentation; if the response is incompatible, it should show some diminution.

Applying these assumptions to Rosenbaum's experiment and further assuming that the simple motor response conditioned in his experiment is one which is relatively compatible with the anxiety-produced response tendencies, it would be expected that the learning of the motor response by the anxious subjects would be greatly facilitated due not only to the intensifying effect of drive on reaction potential but also due to the effect of relatively compatible anxiety-produced responses. In the phase of his experiment when the subjects were presented with the changed stimulus forms, it would also be expected that the anxious subjects would show a heightened gradient of generalized response strength due to both the unconditioned response effect and the energization effect of increased drive. The greater the anxiety drive operating, within certain limits, the

higher the expected gradient of generalization would be. Also, as the drive is a relatively constant variable its effect on generalized response strength would be uniformly manifested along the similarity continuum, i.e., the gradient would be flattened.

Other, but not conclusive, evidence for the latter theoretical formulation, comes from an experiment by Hilgard (9). In this experiment he selected subjects who were high and low in anxiety on the basis of responses to the Taylor-devised manifest anxiety scale (25) and subjected them to a conditioned discrimination situation. First he established a conditioned eyelid response in the subjects to an illumination increase in one of two windows over a period of 60 trials. This was followed by a discriminatory conditioning period in which 30 random illuminations of the learning window (positive stimulus) were invariably followed by an air puff and 30 illuminations of the adjacent window (negative stimulus) were never followed by a puff of air. He obtained a positive (+.12) but non-significant correlation between anxiety and simple conditioning. However, when the relationship between anxiety and lack of discrimination (response to the negative stimulus) was tested he found a significant positive relationship. One interpretation of this finding might be that, even though

the difference in original conditioning between the two groups was not statistically significant, it was sufficient to raise the stimulus generalization gradient of the anxious subjects enough to account for the found differences in discrimination. This interpretation would follow from the Hull-Spence formulation of the multiplicative effect of drive on original and generalized response strength but it ignores the effect of anxiety-induced response tendencies in the conditioning and discrimination situation. If you assume the anxious subjects had reached a somewhat higher level of response strength during original conditioning, you would expect a higher but not significantly higher level of response strength to the negative stimulus, but not the marked difference which Hilgard found between the original conditioning and discrimination situations. However, if you assume that the anxious group achieved a slightly higher level of original response strength due both to the intensifying effects of drive and the presence of anxiety-produced response tendencies allied with the conditioned response[1], and if you assume a uniform augmentation of the generalized response strength of the

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[1] It is recognized by many investigators that the eyelid blinking response is a reaction commonly associated with fear, i.e., in terms of the present formulation, it is a response which is compatible with the anxiety-induced response tendencies.

allied anxiety response tendencies, you would have a flattened stimulus generalization gradient and would expect the found differences in discrimination.

The viewpoint developed above leads to a variety of hypotheses which can be tested experimentally. The present experiment is one which arose out of some of the above theoretical considerations and was designed to investigate the effect of level of anxiety upon stimulus generalization in paired associate learning and recognition memory.

There have been but few studies reported in the literature which have been directed toward exploring the relationship between anxiety and verbal learning, even though a more precise definition of this relationship seems a matter of great theoretical as well as practical importance. Malmo and Amsel (13) have conducted one such study in which they found that subjects who presented severe anxiety symptoms were slower to learn a serial list of nonsense syllables. They concluded that this behavior was due to the anxiety-produced interference between the relevant responses and the irrelevant responses generated out of the patient's anxiety state. They did not, however, define the conditions for the appearance of such interfering effects. More recently, Montague (17) did a somewhat similar study in which he attempted to state more

specifically the effect of anxiety on performance and relate this to the nature of the learning task involved. In his theoretical formulation he assumed that manifest anxiety possesses at least some of the functional properties of drive posited by Hull (10), including that of combining multiplicatively with habit strength. He then hypothesized that anxiety would tend to increase the difference between stronger and weaker response tendencies. In a situation in which relatively weak incorrect tendencies and strong correct tendencies were involved, he predicted that increased anxiety would result in a greater absolute initial difference in opposing tendencies and thus faster learning. In a situation in which relatively weak correct tendencies and strong incorrect tendencies were involved, he predicted that increased anxiety would result in a relatively greater augmentation of incorrect tendencies and so result in poorer performance. In line with this analysis he further assumed that the variables of intralist similarity and association value of nonsense syllables in a rote serial learning situation would affect the relative strengths of correct and incorrect tendencies. Then, by varying these two combined variables three different degrees, he found results supporting his predictions. Under the

condition of high similarity and low association value of syllables, the nonanxious group was significantly superior in learning. Under the condition of low similarity and low association value of syllables the difference was less marked but the nonanxious group was still somewhat superior. And under the condition of low similarity and high association value, the anxious group assumed superiority in learning the list.[2]

In discussing the results, Montague mentioned the possibility that stimuli associated with anxiety itself may elicit responses that compete directly with the responses being learned, the extent of such competition being inversely related to the initial strength of the correct tendencies. However, he felt that this interpretation, taken alone, does not account for the superior performance of the anxious subjects on the easy task. Therefore he discounted the above explanation in favor of the earlier discussed explanation which posits that an increase in drive multiplies with habit strength to produce an increase in reaction potential.

Mandler and Sarason (14) recently completed a study of anxiety and learning which should also be noted here.

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[2] Anxiety level was determined by means of the Taylor anxiety questionnaire (25).

Assuming that anxiety is a drive as discussed by Miller and Dollard, they were concerned with the extent to which the response tendencies associated with the anxiety drive are evoked in a testing situation and the relation of such responses to performance and learning. They found, with the learning tasks used, that subjects high in their measure of anxiety showed greater variation in performance and, in general, performed more poorly than subjects low in anxiety. They interpreted their findings, in part, in terms of the degree to which the responses-to-be-learned were compatible with the anxiety-produced responses. They conjectured that the interference present in the learning of the anxious subjects was due to the presence of relatively incompatible anxiety responses.

Statement of the Problem

The present study represents an empirical investigation of the general hypothesis that the effect of increased anxiety upon performance under stimulus generalization conditions[3] is, in part, a function of the presence of the

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[3] Stimulus generalization conditions or situations, in this paper, will mean conditions in which the presented stimuli have been altered along a similarity dimension from the stimuli of original learning.

conditioned and unconditioned response tendencies associated with the anxiety drive-stimulus.

Anxiety, in the present context, is considered as a drive possessing certain functional characteristics similar to other drive states. Two such assumed properties are that increased drive increases the number and strength of response tendencies present in a situation and that increased drive augments each increment of reaction potential that is accrued in a learning situation. In addition, there is another characteristic of drives which is very important to the present study. This is the drive-stimulus aspect. Within the framework of Hull's theoretical system, every drive is assumed to have stimulus properties. The responses of the drive stimulus tend to be specific to a given drive, and vary in reaction potential as a function of habit strength and drive intensity. It is further assumed that the presence of these response tendencies will facilitate the learning of a response which is relatively compatible with them and interfere with the learning of a response not compatible with them.

Now, assuming that anxiety is a drive and an operative variable, it may be expected to increase the strength of the response tendencies present in a situation and to

augment each increment of reaction potential accrued in a learning situation. These are facilitating effects on the learning process. In addition, due to its drive-stimulus characteristic, anxiety tends to evoke certain responses which are relatively unique to it. Examples of such responses would be startle pattern responses, withdrawal responses, and verbal responses such as "Oh!","I'm doing very poorly", "I'm getting tense", etc. The effect of these anxiety-induced response tendencies would be to facilitate or interfere with learning, depending upon their relation to the response being learned. If the response to be learned is one which is relatively compatible with or a functional component of the anxiety response tendencies, the learning process should show facilitation; if the response to be learned is one which is relatively incompatible with or alien to the anxiety response tendencies, the learning process should show retardation. For example, in an experimental situation in which a response such as the eyeblink is being conditioned, we would expect anxious subjects to be more readily conditioned to make the response than nonanxious subjects. This would be due, in part, to the compatible relationship between the eyeblink response and the anxiety response tendencies. However, in a

learning situation in which a response such as spelling aloud a nonsense syllable is to be learned, we would expect the learning process of anxious subjects to be somewhat retarded. This would be due to the relative incompatibility of the verbal response with the response tendencies characteristic of anxiety.[4]

We also assume that level of the anxiety drive will determine whether the performance of anxious subjects in a verbal learning situation will be superior, equal, or inferior to nonanxious subjects. At a low level of anxiety the facilitating effects of anxiety are expected to predominate and result in superior performance by anxious subjects. At a somewhat higher level of anxiety, the two opposing effects may counterbalance one another and result in equal performance. And, at a high level of anxiety we assume that the interfering effect of competing anxiety-induced response tendencies will predominate and result in inferior performance by anxious subjects.

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[4] This does not mean that the assumption is made here that all verbal responses are incompatible with the response tendencies induced by an elevation of anxiety. In fact, some verbal responses, as noted above, may be strongly associated with the anxiety drive-stimulus. However, nonsense syllables of low associative value are assumed to be relatively incompatible with the response tendencies characteristic of anxiety.

Because of the confounding of the drive-stimulus aspect of anxiety with the other drive characteristics, it is difficult to isolate the effect of the stimulus aspect upon performance. Therefore, a situation was selected in which it was believed it would be more clearly manifest. It was conjectured that the effect of anxiety-induced response tendencies would be most clearly demonstrated under stimulus generalization conditions, because under these conditions the original response tendency would be lowered to a level at which it would come into competition with the response tendencies associated with increased anxiety. As a consequence, the effective strength of the generalized verbal response tendencies is reduced, with this reduction in generalized response strength being constant for each variation of the original stimulus along a similarity dimension. Because of this reduction in generalized response strength, there will be less interference by generalized response tendencies in the learning of new verbal responses to the similar stimuli and less facilitation by the generalized response tendencies in the learning of the same verbal responses to the altered stimuli. In other words, increased anxiety should decrease the negative transfer effect and also decrease the positive transfer effect.

Let us apply these theoretical assumptions more specifically to several experimental conditions. In one such situation a group of subjects high and low in anxiety (anxious and nonanxious subjects) are first presented with a list of nonsense words of low similarity for the purpose of learning a recognition response. After being shown the words for a limited number of learning trials and then matched for performance during those trials, the anxious and nonanxious subjects are placed in a recognition situation. They are requested to select those nonsense words which were presented to them earlier from a random list containing some of the original nonsense words and some which are varied from the original words in terms of structural similarity. Our hypotheses are: (1) that the anxious and nonanxious subjects will show no differences in the number of recognition responses to the original words, (2) that the anxious subjects will make fewer recognition responses to the changed words than the nonanxious subjects for each degree of variation of the words along a similarity dimension, and (3) that the performance gradient of stimulus generalization will be uniformly lower for the anxious subjects because the anxiety-induced response tendencies compete with the generalized response tendencies and reduce the probability of occurrence of the generalized responses.

Figure 1 is an attempt to represent the hypothetical performance of the anxious and nonanxious subjects in this stimulus generalization situation. Reading the figure from left to right, each point on each curve represents the mean number of recognition responses of anxious and nonanxious subjects to the original words, or words varied from one to three degrees of structural similarity to the original words.

Let us now apply our theoretical assumptions to a positive transfer situation. Assume first a situation in which a group of anxious and a group of nonanxious subjects are given individually the task to learn to a given criterion a list of paired associates of low similarity and low associative value. When such subjects are subsequently presented with another list of paired associates, the stimulus members of which are similar to the stimulus members of the original learning list and whose corresponding response members are the same as in the original learning list, we would hypothesize (4) that anxious subjects will give fewer correct responses to the similar stimuli during the first few trials than the nonanxious subjects and (5) that this predicted difference will remain constant for each variation in the stimuli along a given similarity

dimension due to the uniform reduction in effective strength of the generalized response tendencies by the competing response tendencies of the anxious subjects. In Figure 2 is diagramed the expected difference in performance of the anxious and nonanxious subjects when the stimulus members of the transfer list consist of two variations in extent of similarity to the original stimuli. At point 1 and point 2 on the curves are represented the mean number of correct responses to the stimuli of first- and second-degree similarity respectively.

Lastly, if another group of anxious and nonanxious subjects, following the original learning situation described in the paragraph above, are placed in a negative transfer situation to learn a list of paired associates, the stimulus members of which are similar to the stimulus members of the first list and the response members of which are entirely new and different, we would predict (6) that the anxious subjects will give more correct responses to the similar stimuli than the nonanxious subjects and (7) that this predicted difference will be the same for each variation of stimuli. The more rapid learning of the new response is presumed to be due to the reduction in effective strength of the generalized response tendencies which are competing with the learning of any new response. Figure 3

is an attempt to graphically represent the predicted difference in performance of anxious and nonanxious subjects in the negative transfer situation. With the same variations in similarity of stimuli found in the positive transfer situation it is to be noted that the predicted difference is constant at each point along the similarity dimension. This is presumably a function of the relatively constant effect of anxiety-induced response tendencies on generalized response strength at each point along the stimulus similarity continuum.

Summary Statement of the Specific Hypotheses

In the group recognition memory experiment it is predicted: (1) that the anxious and nonanxious subjects will show no differences in the number of recognition responses to the original words, (2) that the anxious subjects will make fewer recognition responses to the changed words than the nonanxious subjects, and (3) that the performance gradient of stimulus generalization will be uniformly lower for the anxious subjects for each degree of variation of the words along a similarity dimension.

In the positive transfer experiment, it is predicted: (4) that anxious subjects will give fewer correct responses to the similar stimuli during the first few trials than the

nonanxious and (5) that this predicted difference will remain constant for each variation of the original learning stimuli.

In the negative transfer situation, it is predicted: (6) that the anxious subjects will give more correct new responses to the similar stimuli than the nonanxious and (7) that this difference in performance will be the same for each variation of the original learning stimuli.

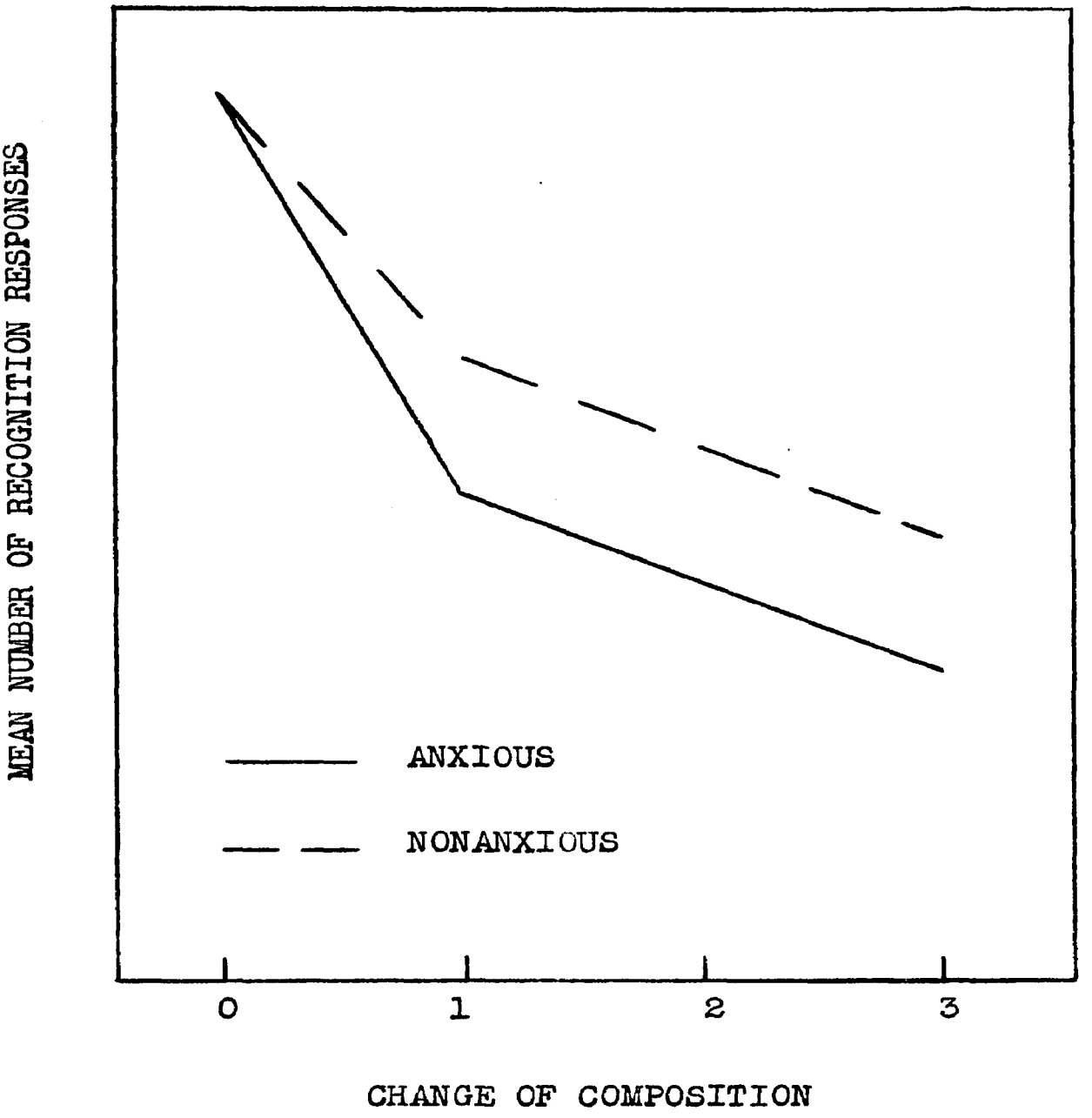

Figure 1. A diagram indicating the predicted differences in performance of anxious and non-anxious subjects in a recognition-memory stimulus generalization situation as a function of anxiety-induced competing response tendencies.

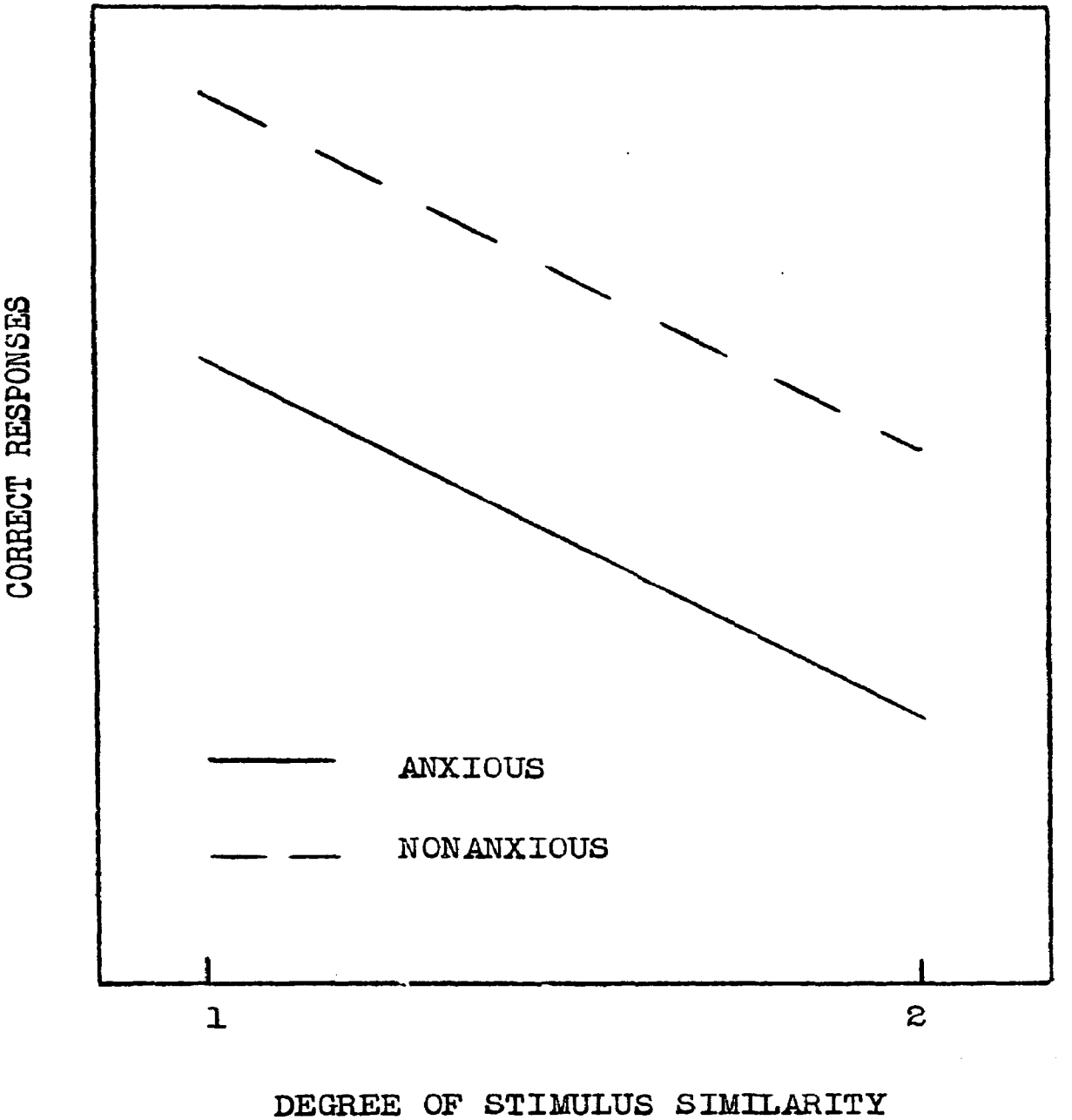

Figure 2. A diagram indicating the predicted differences in performance of anxious and non-anxious subjects in a positive transfer situation as a function of anxiety-induced competing response tendencies.

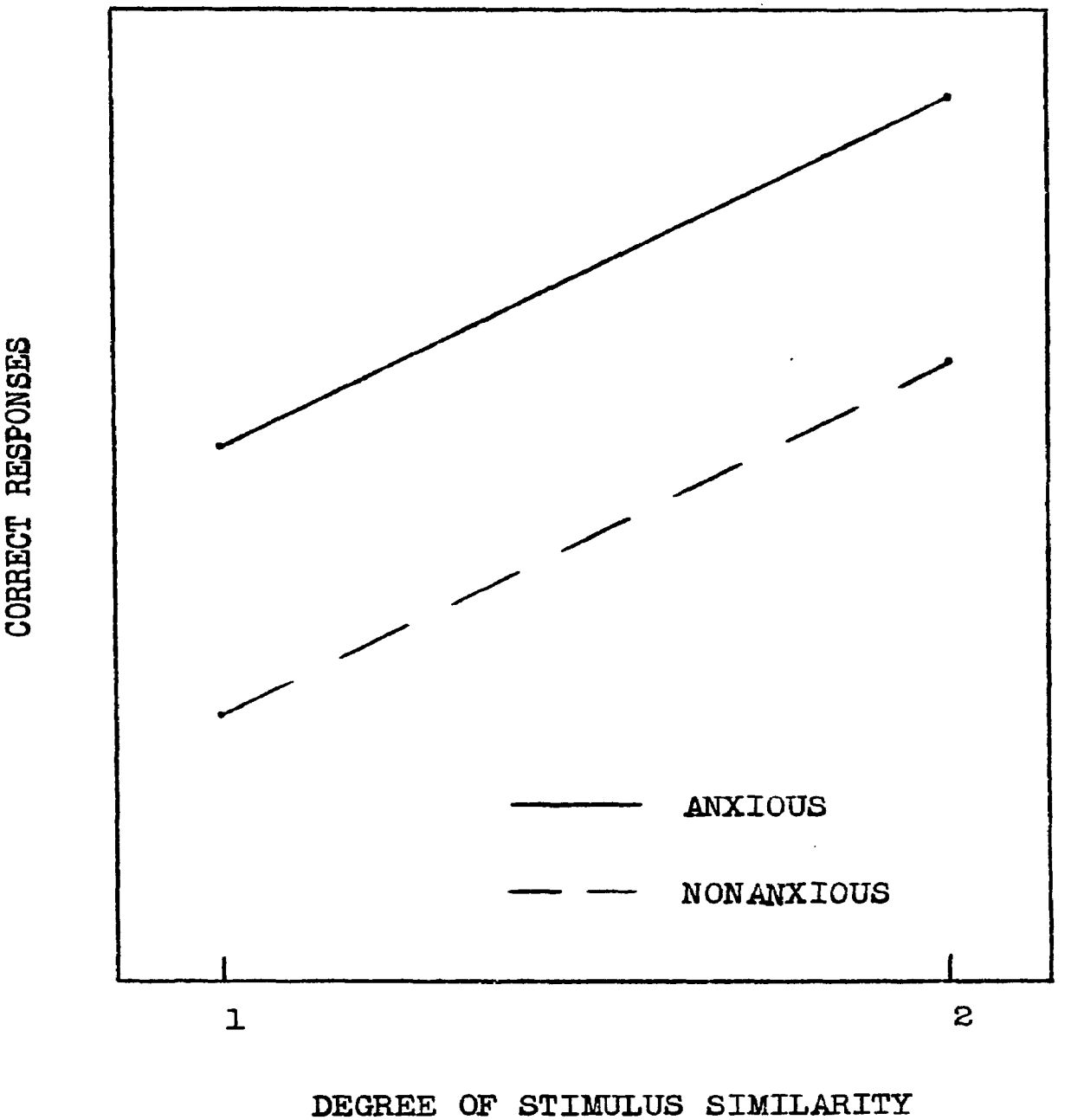

Figure 3. A diagram indicating the predicted differences in performance of anxious and non-anxious subjects in a negative transfer situation as a function of anxiety-induced competing response tendencies.

CHAPTER II

PROCEDURE

Preliminary Selection of Subjects:

The first step taken in this research was the selection of two groups of subjects, high and low in manifest anxiety, from the courses in introductory psychology at Michigan State College. The level of anxiety was determined by means of a modification of an earlier Anxiety Scale described by Taylor (25). This modified scale (a copy of which appears in Appendix A) has been used by Rosenbaum (22), Montague (17), and others (9, 23) to discriminate two levels of anxiety in a college population. It contains the fifty Minnesota Multiphasic Personality Inventory items which have shown the highest correlation with total score on Taylor's (25) original sixty-five item anxiety scale. In addition, the F, K, and L scales on the MMPI were utilized as validity scales to detect false high-or low-anxiety scores.[5] Any

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[5] The F score is a validating score which is utilized in the MMPI to detect carelessness or poor comprehension of items. A low F score is a reliable indication that the subjects responses were rational and relatively pertinent. The K score is used as a correction factor to eliminate subjects whose defensiveness against psychological weakness distorts their responses in the direction of making a more

one of the following served to disqualify a student from the experiment: (1) an F score of 12 or above, (2) a K score of 24 or above, or (3) an L score of 7 or above.

The above scale was administered to 367 students of introductory psychology at Michigan State College. After eliminating false high- and low-anxiety scores by means of the validity scales, the high- and low-anxiety groups were selected from the upper 20% and lower 20% of the distribution of Anxiety Scale scores respectively.[6] The total range of anxiety scores was from 1-38. The range of scores for the selection of the high-anxiety group was from 24 to 38, and for the low-anxiety group it was from 1 to 11.

As all students in the courses in introductory psychology at MSC are required to spend three hours as experimental subjects, for the individual experiments a

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"normal" appearance. The L score is a validating score that affords a measure of the degree to which the subject may be attempting to falsify his scores by choosing the response that places him in the most acceptable light socially. A low score indicates that the true values are probably lower than those obtained. The scores utilized in the present experiment either exactly or more conservatively meet score requirements suggested for invalidation (8).

[6] The basis for utilizing only the upper and lower 20% of the distribution of anxiety scores was to select groups of anxious and nonanxious subjects which would be comparable to the groups selected for experimental procedures by other investigators (17, 22, 23). This provides a common basis for comparison of experimental findings.

list of selected high- and low-anxiety students was submitted to the various classes for scheduling the time of their participation. The students so selected were told only that they were to participate in an experiment on human learning and that they had been randomly selected for such participation from the class lists. As the group experiment was presented to all students present in each class, no separate scheduling was necessary.

Procedure for the Group Experiment - Recognition Memory

Subjects:

The two parts of this group experiment were presented separately to each of the introductory psychology classes who had previously completed the Anxiety Scale. Part I was presented on one day and Part II was presented on the following day. After completion of the first part of the experiment, 32 subjects of the high anxiety group were selected and matched with 32 subjects of the low anxiety group on the basis of the recognition scores achieved during the first part of the experiment. These subjects comprise the principal experimental group.

Recognition Memory, Part I, Learning:

The purpose of Part I of this experiment was to provide individual measures of learning which could be used as

measures of the amount of learning which took place in Part II of the experiment prior to the test for stimulus generalization. This procedure was necessary in order to match a group of high anxiety subjects with a group of low anxiety subjects for learning prior to generalization. The means by which the validity of the use of Part I recognition scores as a measure of Part II learning was established is described in Appendix B.

The subjects were presented with a list of 28 three-letter nonsense syllables.[7] These syllables were so selected as to yield a randomized distribution of consonants and vowels in terms of frequency of use and position in the syllables. No sequence of two or more letters appeared more than once in the list. To control for differences in difficulty, the syllables were selected from the lists of Glaze (5) on the basis of their having an associative value of either 13.33% or 20.00%. The average associative value was 17.14%. Examples of the syllables are: JAT, MOX, TUV. Each syllable was printed in solid black capitals ($\frac{1}{2}$ inch high) on white cards (2x7 inches) by means of a hand printing apparatus. To facilitate presentation of the syllables with a projector, the cards were then joined

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[7] Complete lists of the syllables and words used in Parts I and II of this experiment, appear in Appendix C.

with heavy gummed paper to form a continuous tape for each of four sequences of the list. The order in which the syllables of each sequence were arranged was randomized.

Prior to being presented with the above list of 28 nonsense syllables, the following instructions were given to the subjects: "I am going to show you a series of three-letter nonsense syllables, i.e., words which have no dictionary meaning. I want you to study each syllable carefully since your memory for these words is to be tested. The series will be shown several times, each time in a different order. Do not try to memorize any of the orders since you will not be required to remember them in any particular order. Just concentrate on the words themselves."

The cards were then exposed to each group by means of a Bal optican opaque projector at a 2-second rate of exposure. The list was presented four times, each time in a different random order. There was an interval of 10 seconds between each series.

Recognition Memory, Part I, Recognition:

Immediately following the learning trials, the subjects were given a recognition test. This test list contained 56 syllables of which 28 were the syllables presented for learning and 28 were new and different syllables with not

more than one consecutive letter in common with the original ones. The associative value of the new syllables was the same as that of the learned syllables according to Glaze (5).

Each subject was handed face-down a sheet on which the 56 items were arranged in random order and a record sheet on which to indicate their choices of the syllables presented for learning. Before turning the sheets over, the subjects were given the following instructions: "On the first sheet you will find a list of 56 nonsense syllables which are numbered consecutively from 1 to 56. Within this list are the 28 syllables you have just seen as well as some new ones. I would like to have you go through this list and pick out those syllables you recognize as having been on the list you have just seen. As soon as you recognize a word, place a mark in the first column of the record sheet opposite its number. It is your job to pick out a total of 28 words. Try to get as many as you can the first time you go through the list; but if on the first reading of the list you have not picked out 28 words, start again and continue through the list until you have a mark beside 28 of the first 56 numbers on your record sheet. It may be necessary for you to guess in order to fill your quota of 28 items. I want you to guess, if necessary. Experiments have shown that when people guess on such a test, they are more often right

than wrong. Be sure to pick out 28 words, no more, no less. When I say 'Go,' turn over your recognition sheets and start picking out the words you recognize. Try to work as fast and accurately as you can. As soon as you have finished, turn your sheets over. Any questions? O.K. Ready - Go!" The instructions appear to have been clear and adequate, as there were few questions raised. Those which were asked were answered by restating that part of the instructions appropriate to the question.

Recognition Memory, Part II, Learning:

On the following day, the subjects learned a list of 24 six letter nonsense words which were so constructed as to yield a thoroughly randomized list of consonants and vowels, both with respect to frequency of use of the different letters and their positions in the words.[8] No sequence of two or more letters appeared more than once in the list. Some examples of these words are: DACTUV, MEYBIP, RIJKAF. Each word was individually printed in solid capitals on six white cards. Six random sequences of the list of 24 words were then selected and joined to

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[8] This learning list and the recognition lists which follow were taken from lists originally constructed by Postman (20) and made available by him through the American Documentation Institute, 1719 N. Street, N.W., Washington, 6, D.C. (Document 3406).

form six continuous tapes. The method by which this was done duplicates that described previously for the nonsense syllables in Part I of this experiment.

Prior to learning, the subjects were given the following instructions: "Yesterday you were shown and asked to memorize a series of three-letter nonsense syllables. You are going to be asked to do something similar today. This time, however, I am going to show you a series of six-letter nonsense words which have no dictionary meaning. Again I want you to study each word carefully since your memory for these words is to be tested. The series will be shown a few times more than the list you memorized yesterday, and each time it will be arranged in a different order. Concentrate on each of the words as it appears on the screen." The exposure rate for the words was 2-seconds and the series was presented six times in different random orders. There was an interval of 10 seconds between series.

Recognition Memory, Part II, Recognition:

For this part of the experiment, the subjects were each given one of four recognition tests. The following structural composition was common to each test: Each contained 24 nonsense words of which 6 words from the original list were unchanged, 6 words from the original

list were changed by one letter, 6 words from the original list were changed by two consecutive letters, and 6 words from the original list were changed by three consecutive letters. Thus, the 24 words on the learning list were subdivided into four groups, each representing a different degree of similarity (defined by number of common elements) to the original words. The number of common elements ranged from six (no change) to three (three-letter change). None of the variations had two or more letters in common with any word other than the one from which it was derived. For each type of change, the positions within the word at which the alterations were made were systematically varied. Thus, one-letter changes were made at each of the six possible positions within the word; consecutive two-letter changes were made at positions 1-2, 2-3, 3-4, 4-5, 5-6; finally, consecutive three letter changes were made at positions 1-2-3, 2-3-4, 3-4-5, 4-5-6. The frequency of different positions of change was equalized as closely as possible.

As a control for differences in difficulty, the list of 24 words was divided into four groups of words, and each of the four groups was subjected to all the possible changes, with frequencies of different positions of change equalized. Then the four recognition tests were constructed so that

each type of change applied to each group of words. On each list the order in which the words were arranged was randomized.

Following the learning trials of Part II of this experiment, the 32 matched pairs of high and low anxiety subjects were each given one of the above four recognition tests, eight pairs being assigned to each test. In addition, each subject was given a record sheet on which to mark his choices of the words presented for learning. Preceding commencement of this task the following instructions were given: "On this sheet you will find a list of 24 nonsense words which are numbered consecutively from 1 to 24. Within this list are some of the 24 words you have just seen as well as some new ones. I would like to have you go through this list and pick out those syllables you recognize as having appeared on the screen. As soon as you recognize a word, place a mark in the first column of the record sheet opposite its number. You are not asked to pick out any specified number, rather, just go through the list and pick out those words you think appeared on the screen a few minutes ago. Try to get as many as you can the first time through; but, if on the first reading of the list you think there are still some words which should be checked, go back through and indicate those words.

When I say 'Go,' turn over your recognition sheets and start picking out the words you recognize. Try to work as fast and accurately as you can. As soon as you have finished, turn your sheets over. Any questions? Ready - Go!" Ample time was allowed for all subjects to complete the task.

Procedure for the Individual Experiments
Positive and Negative Transfer

Apparatus:

Two memory drums were used in the individual experiments. One drum was used to present the original learning figure-nonsense syllable paired-associates and the other to present the transfer paired-associates. Each drum was set to present a figure or a figure-syllable combination every two seconds. However, after each randomly arranged sequence of a particular paired-associate list was presented, there was an interval of eight seconds when no learning material was exposed. During that time the exposure slot, which was in a sliding panel on the front of the memory drum, was shifted to a different position on the drum for presentation of one of three other arrangements of the list.

Stimulus Materials:

Six lists of 8 paired-associate units were employed as stimulus materials. Two lists were used in the original learning situation, two in the positive transfer situation, and two in the negative transfer situation. The stimulus members of all the paired-associate units were geometric figures and the response members were nonsense syllables. The stimulus members of each of the two lists of 8 paired-associate units used in the original learning situation consisted of eight of Gibson's (4) thirteen standard figures. These are shown on the left hand side of Table VI in Appendix C which contains the original learning lists. The stimulus members of each of the four lists of 8 paired-associate units used in the positive and negative transfer situations consisted of eight additional figures from Gibson (4). Four of these figures correspond to four of the standard figures and have first-degree similarity to them and four figures correspond to the other four standard figures and have second-degree similarity to them.[9] These eight figures appear on the left hand side of Tables VII

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[9] Gibson (4) originally determined the two degrees of similarity of these figures to the standard figures by the method of subjective ratings. She substantiated the validity of this scaling procedure in an experimental situation.

and VIII in Appendix C. (Table VII contains the positive transfer lists and Table VIII the negative transfer lists). The degree of similarity of these figures to the standard figures of Table VI is indicated in the center column of each table.

The response members of the paired associate units used in the original learning and positive transfer lists were eight three-letter nonsense syllables having an average association value of 4.17% according to Glaze (5). The response members of the negative transfer lists were eight additional nonsense syllables having the same associative value as the first eight syllables. All sixteen syllables were selected so that there would not be more than one common letter between any two of them.

The purpose of having two lists for original learning was to insure that any differences in nonsense syllable difficulty would not produce differential amounts of learning to the figures to be involved in first-degree generalization and second-degree generalization. Likewise the purpose of the two lists used in each of the two transfer situations was to control for differences in nonsense syllable difficulty which might produce differential learning to the figures of first-degree similarity and the figures of second-degree similarity.

Tables I and II illustrate how the above controls were established. Table I is a symbolic representation of the stimulus and response members of the paired-associate units used in the original learning and transfer situations. Referring to the left side of the table, it is noted that in the original learning situation, the standard stimulus figures (S) remain constant for each list while the response syllables (R) are varied. The first four stimulus symbols (S_1, S_2, S_3, S_4) represent the standard figures involved in first-degree generalization. The second four stimulus symbols (S_5, S_6, S_7, S_8) represent the standard figures involved in second degree generalization. Now, by alternating the list 1 response syllables R_1, R_2, R_3, R_4 with the list 1 response syllables R_5, R_6, R_7, R_8 on list 2, each set of four syllables is paired once with each set of four standard figures for learning. However, the experimental control is not established until an equal number of subjects from each experimental group is assigned to each of the two lists. Table II, which presents the assignment of subjects to the original learning and transfer lists, shows how this procedure was carried out.

The counterbalancing procedures used in the two transfer situations to control for nonsense syllable difficulty are essentially the same as the one outlined above for the

TABLE I

A SYMBOLIC REPRESENTATION OF THE STIMULUS AND RESPONSE MEMBERS OF THE PAIRED-ASSOCIATE LISTS USED IN THE ORIGINAL LEARNING AND TRANSFER SITUATIONS OF THE INDIVIDUAL EXPERIMENTS

ORIGINAL LEARNING			POSITIVE TRANSFER			NEGATIVE TRANSFER		
Standard Stimulus Figures	Nonsense List 1	Syllables List 2	Altered Stimulus Figures*	Nonsense List 3	Syllables List 4	Altered Stimulus Figures*	Nonsense List 5	Syllables List 6
S_1	R_1	R_5	S_11	R_1	R_5	S_11	R_9	R_{13}
S_2	R_2	R_6	S_21	R_2	R_6	S_21	R_{10}	R_{14}
S_3	R_3	R_7	S_31	R_3	R_7	S_31	R_{11}	R_{15}
S_4	R_4	R_8	S_41	R_4	R_8	S_41	R_{12}	R_{16}
S_5	R_5	R_1	S_52	R_5	R_1	S_52	R_{13}	R_9
S_6	R_6	R_2	S_62	R_6	R_2	S_62	R_{14}	R_{10}
S_7	R_7	R_3	S_72	R_7	R_3	S_72	R_{15}	R_{11}
S_8	R_8	R_4	S_82	R_8	R_4	S_82	R_{16}	R_{12}

*The numbers 1 and 2 on the right in these columns refer to first and second degree similarity of the altered stimulus figures to the standard stimulus figures.

TABLE II

ASSIGNMENT OF SUBJECTS TO THE ORIGINAL LEARNING AND TRANSFER LISTS FOR THE PURPOSE OF CONTROLLING DIFFERENCES IN NONSENSE SYLLABLE DIFFICULTY

EXPERIMENTAL CONDITION	NUMBER OF SUBJECTS	ORIGINAL LEARNING LIST NUMBER*	TRANSFER LIST NUMBER*
Positive Transfer			
Anxious	7	1	3
	8	2	4
Nonanxious	7	1	3
	8	2	4
Negative Transfer			
Anxious	5	1	5
	5	1	6
	5	2	5
	5	2	6
Nonanxious	5	1	5
	5	1	6
	5	2	5
	5	2	6
Error Group			
Anxious	5	1	3
	5	2	4
Nonanxious	5	1	3
	5	2	4

*The numbers in these columns refer to the list numbers at the top of the columns in TABLE I.

original learning situation. By referring to Table I you can see that the first four response syllables are alternated with the second four syllables on the two lists utilized in each transfer condition. Table II then shows how the assignment of subjects to the lists established the desired control.

Each list of paired-associates was presented in four sequences, each sequence being arranged in adjacent columns on a memory drum tape. In each sequence the order of the pairs was random except that two of the four sequences commenced and two ended with units whose stimulus members were involved in first-degree generalization, and the other sequences commenced and ended with units, whose stimulus members were involved in second-degree generalization. This feature of the experimental design was employed as a control for position effects. Preceding every figure-syllable unit in each column on the tape, the stimulus figure of the unit was placed alone. By this arrangement, each stimulus figure could be presented in the window of the memory drum alone and followed by presentation of the figure-syllable combination.

Subjects:

Forty-five subjects from the high-anxiety group and forty-five subjects from the low-anxiety group participated

in the original learning situation. Of these subjects twenty of the high-anxiety group and twenty of the low-anxiety group participated in the negative transfer situation and fifteen of each group participated in the positive transfer situation. The ten remaining subjects in each group participated in what was to have been a positive transfer situation but which contained methodological errors making it unsuited for testing the present hypothesis. This latter situation will not be considered here. The assignment of subjects to the transfer situations was random except that approximately an equal number of female subjects from the high- and low-anxiety groups were assigned to each of the two transfer conditions.

Original Learning:

The forty-five high-anxiety and forty-five low-anxiety subjects learned a list of eight figure-syllable units to a criterion of one errorless trial. The composition of the units was alternated with one half the subjects from each group learning one arrangement of the list and the other half learning the other arrangement (Table VI, Appendix C). No subjects were eliminated for failure to reach the criterion.

The subjects were seen individually by the experimenter in a small relatively isolated room. Each subject was

seated comfortably in a wooden chair in front of the experimental apparatus with his eye level just above the exposure window of the memory drum. This was accomplished by regulating the height of the drum from the table. The instructions given the subjects prior to learning the first list were as follows: "Today you are going to participate in a learning experiment. It will involve the use of the apparatus you see in front of you, called a memory drum. The memory drum is simply a cylinder or drum that is mounted inside this box next to the little window. Behind the drum in the box is a small electric motor that rotates the drum about an inch every two seconds. Now, on this drum I have arranged several different sequences of eight geometric forms and eight nonsense syllables. They are arranged in the same way as these examples are arranged on this model drum." (At this point the subjects were shown a model drum that had arranged on it simple geometric forms such as a circle, a square, and a triangle paired with 3-letter alphabetical sequences such as ABC, JKL, XYZ, etc. The arrangement of the figures and pairs followed that found on the experimental drum.) "As you see, there are four random arrangements of the same list of pairs across the drum, i.e., the pairs always remain the same but the order in which they are arranged is changed each time. Around the drum, the lists

are arranged as follows: First there is a figure and then the same figure paired with a nonsense syllable, another figure and the same figure paired with another nonsense syllable, and so on around the drum. The figures and figure-syllable combinations are arranged in this way so that you can be presented in this window with first the figure and then the pair. Several lists of the same pairs are used so that the pairs are not presented in any regular order. Now, your task is to learn to spell out loud the nonsense syllable that goes with a particular figure when that figure appears alone in the window. I would like you to do this in the following manner: The first time you are shown the list, spell out loud each nonsense syllable as it appears in the window with its figure. After that, whenever the figure appears alone in the window and you think you know what the nonsense syllable is that goes with it, spell that syllable aloud. I will show you the list, arranged in a different order each time, as many times as it is necessary for you to correctly spell out loud all the nonsense syllables on one trial. There will be an interval of several seconds between each list. Don't be afraid to make mistakes, because everybody does. Remember, after the first presentation of the list, when you have spelled aloud all the nonsense syllables as they appeared

with the figures, you are to learn to spell aloud the nonsense syllables when the figures are presented alone. Do you have any questions? All right, we will proceed with the experiment.'

Following the presentation of the instructions, the experimenter seated himself behind the memory drum apparatus out of the direct view of the subject. He recorded the responses of each subject on forms specially prepared for that purpose.

Positive Transfer:

Thirty subjects, fifteen from each group (high- and low-anxiety), participated in this experiment. Immediately following the original learning situation, each subject was presented with another list of eight paired-associate units (Table VII, Appendix C) on a memory drum and given instructions to learn this list as he had the previous list. The list was presented until the subject achieved a criterion of eight correct responses on one trial.

The instructions given the subjects were as follows: "You are now going to be presented with another list of eight geometric figures paired with eight nonsense syllables. I would like you to learn them in the same manner you learned the first list, that is, during the first presentation of the list, spell out loud each nonsense syllable as it appears

in the window with the figure. After the first presentation of the list, whenever a figure appears alone in the window and you think you know what it is, spell it out loud. You will be shown the list as many times as it is necessary for you to correctly spell aloud all of the nonsense syllables during one complete presentation of the list."

Upon achieving the criterion of one errorless trial, the experiment was stopped. Each subject was then thanked for his cooperation and asked not to discuss the content of the experiment with his friends.

Negative Transfer:

Forty subjects participated in this experiment, twenty being randomly selected from the high-anxiety group and twenty randomly selected from the low-anxiety group. Immediately following the original learning situation, each subject was presented with a negative transfer list (Table VIII, Appendix C) and given instructions to learn it as he had the previous list. The list was presented for ten trials.

The instructions given to these subjects were as follows: "You are now going to be presented with another list of eight geometric figures paired with eight nonsense syllables. I would like you to learn them in the same

manner you learned the first list, that is, during the first presentation of the list, spell out loud each nonsense syllable as it appears in the window with the figure. After the first presentation of the list, whenever a figure appears alone in the window and you think you know what it is, spell it out loud. You will be shown the list as many times as it is necessary for you to correctly spell aloud all of the nonsense syllables during one complete presentation of the list."

Upon completion of the tenth trial, the experiment was stopped. Each subject was then thanked for his cooperation and asked not to discuss the content of the experiment with his friends.

CHAPTER III

RESULTS

The Group Experiment - Recognition Memory

Part I. Learning and Recognition:

A comparison of the recognition scores of the 56 high-anxiety and 54 low-anxiety subjects, who were present on the day this part of the group experiment was presented in class, revealed that both groups achieved the same mean score of 20.9 correct nonsense syllable identifications out of the 28 possible. The standard deviations for the high and low groups were 3.28 and 2.91 respectively. These findings of equal measures of central tendency and approximately equal measures of variability indicated that it was unnecessary to match the two groups on the basis of the recognition scores of Part I for Part II of this experiment. However, the matching procedure had some value in that it assured an equal number of subjects, who had achieved the same Part I recognition scores, for each of the four recognition tests used in Part II of the experiment.

Part II. Learning and Recognition:

Performance curves, plotted for the 32 anxious and 32 nonanxious subjects, exactly matched on the basis of

their learning scores on Part I, are presented in Figure 4. The points on the curves reading from left to right represent the mean number of recognition responses to the original nonsense words and those words changed by 1, 2, and 3 consecutive letters. A study of these curves reveals that, in accordance with the first experimental hypothesis the anxious group made practically the same number of responses to the original nonsense words. However, comparison of the responses to the changed words indicates a distinct and consistent trend for the anxious subjects to respond less often to the altered stimuli in line with the second experimental hypothesis.

The above noted difference between the performance of the anxious and nonanxious subjects under stimulus generalization conditions was tested by means of an analysis of variance. A summary of this analysis is presented in Table IX, Appendix D. It reveals several interesting findings. For one thing, the difference in the performance of the two groups is significant beyond the five percent level of confidence, the F ratio being 5.97 with 1 and 62 degrees of freedom. The analysis also reveals that the interaction between the two levels of anxiety and the changes in composition of the nonsense words is not significant, i.e., the trends in the two performance curves do not differ.

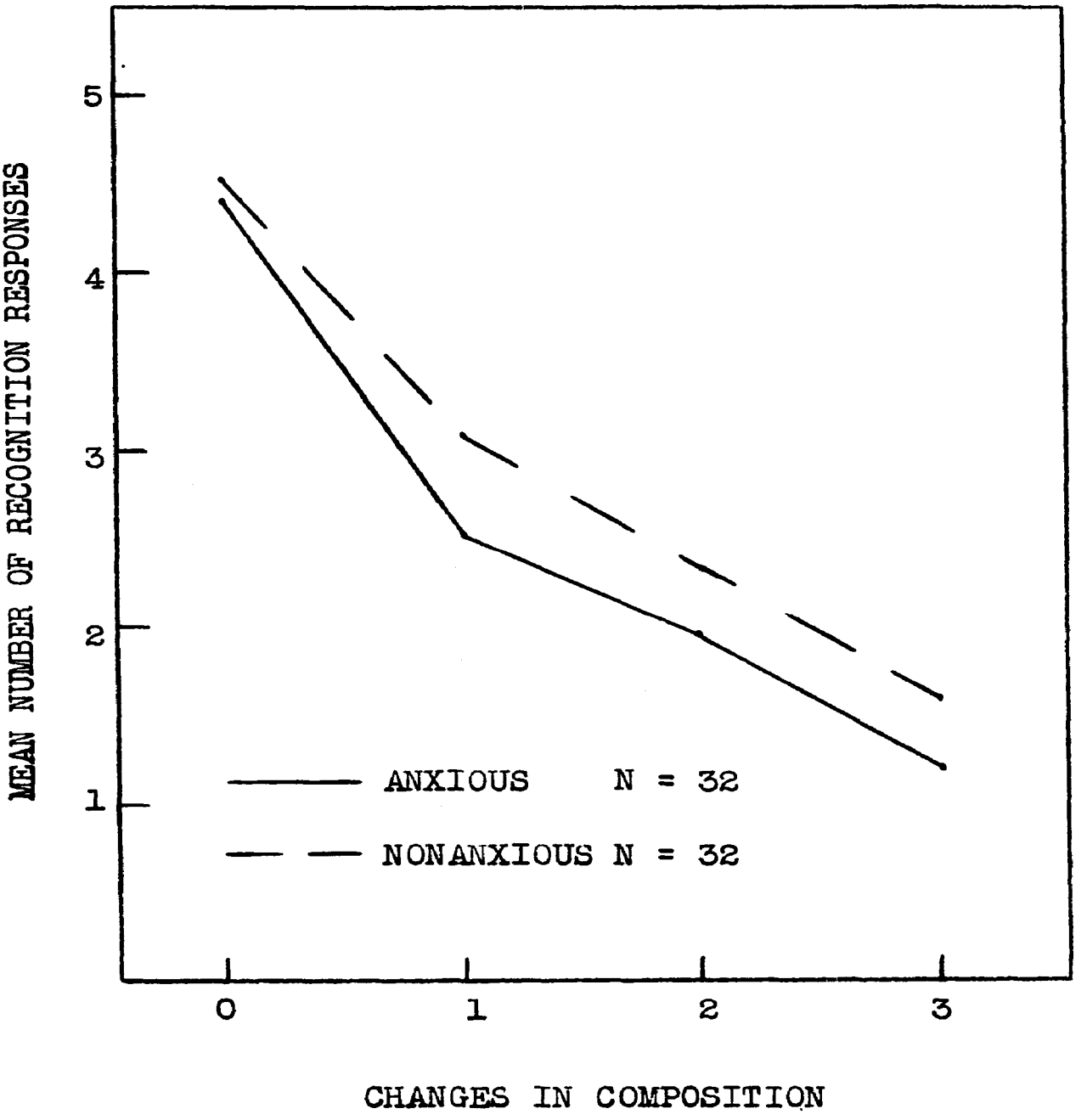

Figure 4. Performance curves for the Recognition Memory Experiment, Part II. Each point on the curves represents the mean number of recognition responses of anxious or nonanxious subjects to the original nonsense words or words changed by 1, 2, or 3 consecutive letters.

Although not directly pertinent to the hypothesis being tested, it is of some interest to note another finding of the analysis of variance. This aspect of the analysis was concerned with the interaction between both groups of subjects combined and change of composition of the nonsense words. It was found that there is a very significant difference in the performance of the pooled subjects as a function of change in composition, the F ratio being 81.5 with 3 and 186 degrees of freedom. This means that a clear-cut stimulus generalization gradient obtained in this portion of the experiment.

Due to the nature of the experimental design it was possible to secure empirical data on the effect of differences in degree of original learning on the amount of stimulus generalization present under recognition memory conditions. By selecting from all subjects participating in Parts I and II of the group experiment, 6 subjects from each of the four subtest groups who had participated in Part II of the experiment and achieved Part I recognition scores of 14-19 (lower extreme) and 6 subjects from each of the four subtest groups who had participated in Part II of the experiment and achieved Part I recognition scores of 25-28 (upper extreme), it was possible to have two groups who presumably differed in level of learning prior

to the test of generalization. The effect of anxiety was controlled in the above selection procedure as it yielded 6 anxious and 7 nonanxious subjects for the slow learning group and 4 anxious and 6 nonanxious subjects for the fast learning group, with the remaining subjects being drawn from the intermediate range of anxiety scores.

The performance curves of Part II data for the two learning groups are presented in Figure 5. They indicate that the fast learners made slightly more recognition responses to the original nonsense words, but much fewer recognition responses to the altered words at each point along the similarity dimension. An analysis of variance was used to test the significance of the differences in number of recognition responses made by the two groups to the altered words (Table X, Appendix D). It yielded an F of 7.93 with 1 and 47 degrees of freedom, which is significant beyond the one percent level of confidence. This finding of a reduction in amount of stimulus generalization as the level of learning is raised is much like the findings reported by several other investigators. Razran (21), summarizing the Pavlovian and Yale studies of conditioned response generalization, stated that CR generalization increases in the very early stages of learning, then slowly decreases and then again increases.

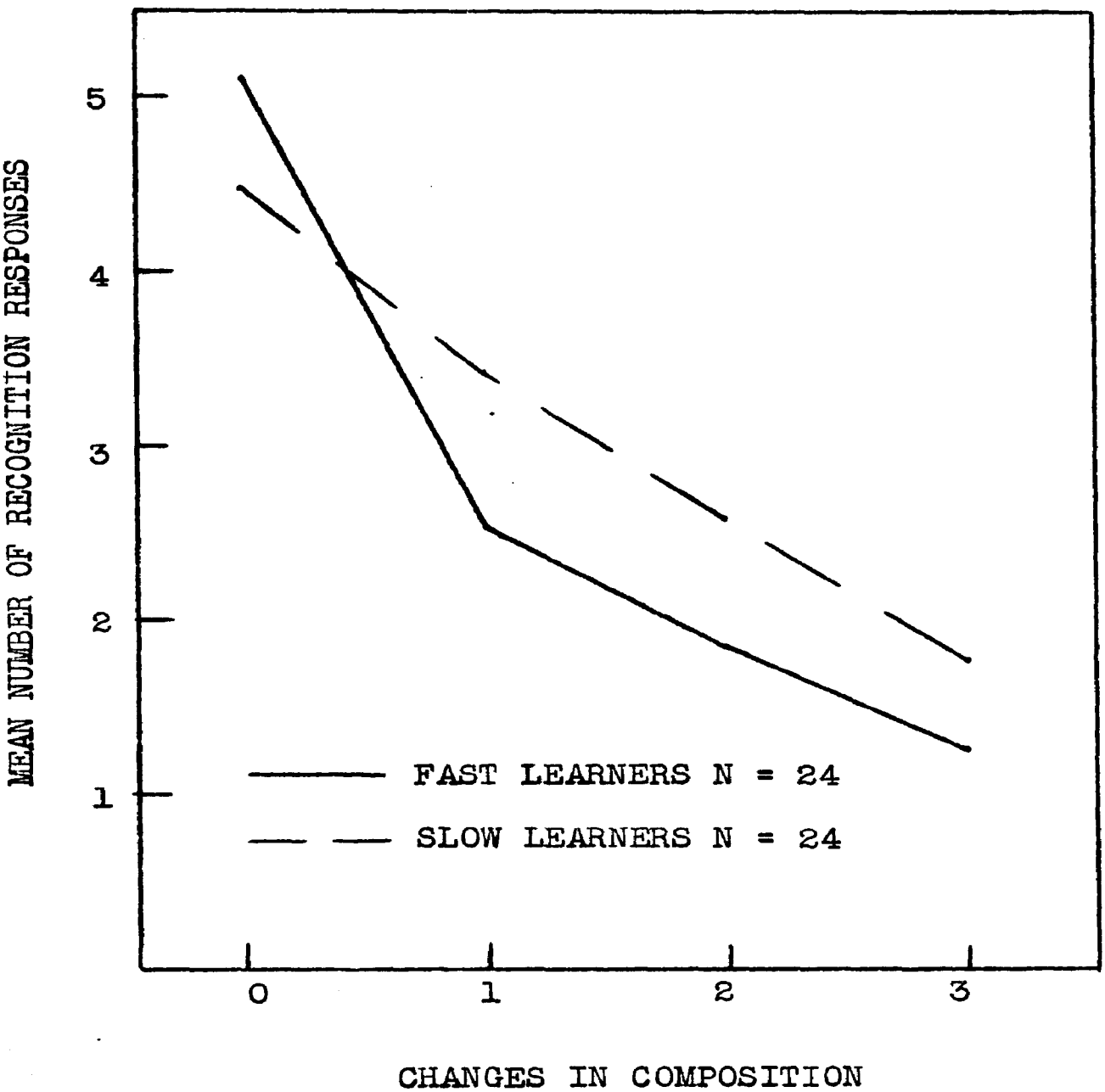

Figure 5. Performance curves from the Recognition Memory Experiment, Part II. Each point on the curves represents the mean number of recognition responses to the original and changed words by two groups of subjects, one of which achieved Part I recognition scores of 14-19 (slow learners) and the other of which achieved Part I recognition scores of 25-28 (fast learners).

Gibson (4) also reached a somewhat similar conclusion in her classical work on stimulus generalization in verbal learning. She found that stimulus generalization was greatest during the early part of the learning process, but as learning progressed, generalization decreased.

The Individual Experiments - Positive and Negative Transfer

Original Learning:

The mean number of correct responses and the mean number of trials to criterion of the 45 anxious and 45 nonanxious subjects, who participated in the original learning situation, are presented in Table III. A comparison of these scores indicates that the anxious subjects achieved the criterion of one errorless trial on the average of only 1.4 trials sooner than the nonanxious. It also shows that there was essentially no difference between the groups in the number of correct responses made during the learning trials.

To determine the statistical significance of the above differences an analysis of variance and an analysis of covariance were made. The analysis of variance was concerned with the difference in the mean number of trials necessary to attain the criterion. The result of this analysis, presented in Table XI of Appendix D, shows that

TABLE III

MEAN NUMBER OF TRIALS-TO-LEARN AND MEAN NUMBER OF CORRECT RESPONSES OF THE ANXIOUS AND NONANXIOUS SUBJECTS DURING THE ORIGINAL LEARNING SITUATION OF THE INDIVIDUAL EXPERIMENTS

Experimental Group	N	Mean Number of Trials to Learn	S.D.	Mean Number of Correct Responses	S.D.
Positive Transfer					
Anxious	15	28.8	12.31	104.1	38.36
Nonanxious	15	32.2	12.90	109.3	28.00
Negative Transfer					
Anxious	20	29.2	13.93	100.7	37.94
Nonanxious	20	32.2	12.69	105.1	49.31
Other					
Anxious	10	33.4	16.11	111.5	48.42
Nonanxious	10	28.5	16.88	93.1	30.21
Total					
Anxious	45	30.0	14.06	104.2	40.87
Nonanxious	45	31.4	12.46	103.8	43.33

the difference was not significant. The analysis of covariance was concerned with the difference between the two groups in the number of correct responses made during the learning trials. However, when the means of the anxious and nonanxious subjects for this performance measure were adjusted to a common trials-to-learn basis, it was found that the two groups do not differ significantly in this regard (Table XII, Appendix D). Using the above measures, then, the anxious and nonanxious subjects did not differ in amount of original learning.

To secure an additional measure of possible differences between the groups in rate of learning, the number of trials necessary to elicit the first correct response and each of the seven successive first responses to the various stimulus figures was ascertained for each subject. These data are summarized for each group in Figure 6. It shows that the anxious group took a slightly greater mean number of trials to produce the first correct response, but afterwards they correctly responded to each other syllable for the first time from 1 to 3 trials sooner than the nonanxious group.

Table XIII, Appendix D, presents the results of an analysis of variance employed to test the difference in rate of learning shown in Figure 6. With an F of 3.67 and 1 and 88 degrees of freedom, the difference is

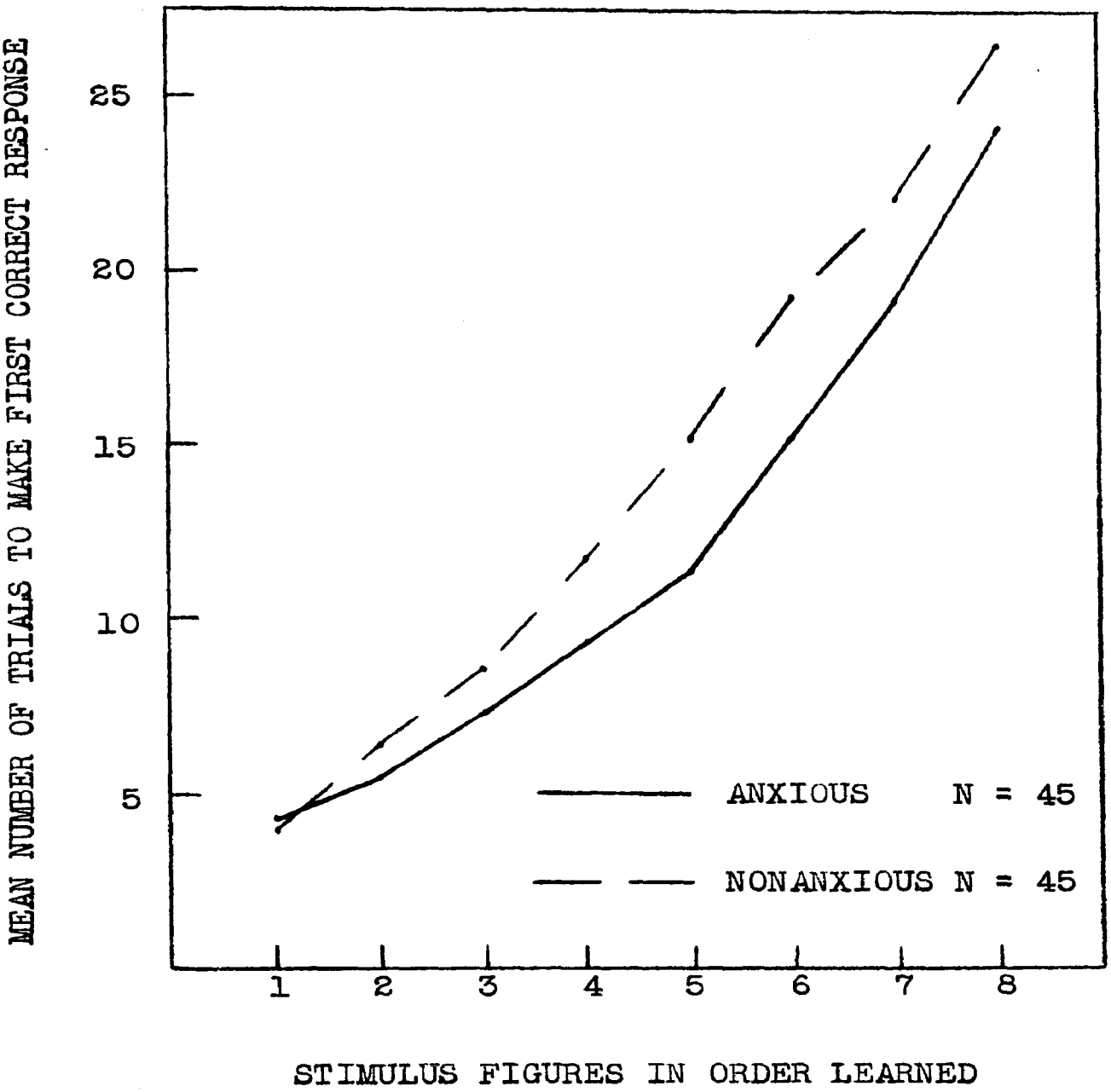

Figure 6. Performance Curves from the Individual Experiment, Original Learning. Each point on the curves represents the mean number of trials necessary for the anxious and nonanxious subjects to give the first correct response to each of the eight stimulus figures in the order learned.

significant between the five and ten percent level of confidence. Therefore, the anxious subjects do show some evidence of learning more rapidly in the individual experimental situation particularly after the early stages of the learning process. This finding is in keeping with the theoretical views outlined in the Introduction, indicating that the facilitating effects of the anxiety drive tended to predominate in this learning situation.

Inasmuch as four of the standard figures were later varied to one-degree of similarity and the other four standard figures were later varied to a second-degree of similarity, it was desirable to determine if there were any differences in learning between the anxious and non-anxious groups in terms of the mean number of correct responses to each of the two sets of four figures. Two analyses of variance (Tables XIV and XV, Appendix D) were used for this purpose. Neither analysis yields an F ratio approaching significance.

In the process of organizing the data for the above comparisons, it was noted that in each group there was a difference in the mean number of correct responses made to the standard figures later varied to one-degree of similarity and the standard figures later varied by a second-degree of similarity. Upon combining the individual measures from

both groups, it is found that there was a mean of 114.8 correct responses to the first-degree standard figures and a mean of 95.2 correct responses to the second-degree standard figures. Utilizing again an analysis of variance technique to determine the importance of this variation in performance, it is found that the difference is significant beyond the one percent level of confidence, the F ratio being 8.04 with 1 and 178 degrees of freedom (Table XVI, Appendix D).

The analyses above indicate that the difficulty of the two groups of four figures used in the original learning list was not controlled and that both groups probably attained a higher level of learning in response to the standard figures later varied to first-degree similarity than to the other standard figures. However, and more important in terms of the experimental hypotheses, there were no significant differences between the anxious and nonanxious groups in response to either set of standard figures.

Positive Transfer:

In the positive transfer situation it was expected that the anxious subjects would show less transfer than the nonanxious subjects. However, the results of the experiment (summarized in Figure 7 and Table IV) show

TABLE IV

MEAN NUMBER OF CORRECT RESPONSES DURING TRIALS 1-3 AND MEAN NUMBER OF TRIALS TO CRITERION OF THE ANXIOUS AND NONANXIOUS SUBJECTS UNDER THE POSITIVE TRANSFER CONDITION

Experimental Group	N	Mean Number of Correct Responses	S.D.	Mean Number of Trials	S.D.
Anxious	15	10.5		6.5	3.32
Nonanxious	15	10.0		6.6	2.96

TABLE V

MEAN NUMBER OF CORRECT RESPONSES TO THE CHANGED FORMS OF FIRST- AND SECOND-DEGREE SIMILARITY OF THE ANXIOUS AND NONANXIOUS SUBJECTS DURING THE TEN TRIALS OF THE NEGATIVE TRANSFER CONDITION

Experimental Group	N	Mean Number of Correct Responses to Forms of First Degree Similarity	S.D.	Mean Number of Correct Responses to Forms of Second Degree Similarity	S.D.
Anxious	20	12.7	5.57	16.5	6.26
Nonanxious	20	8.6	5.70	11.5	5.43

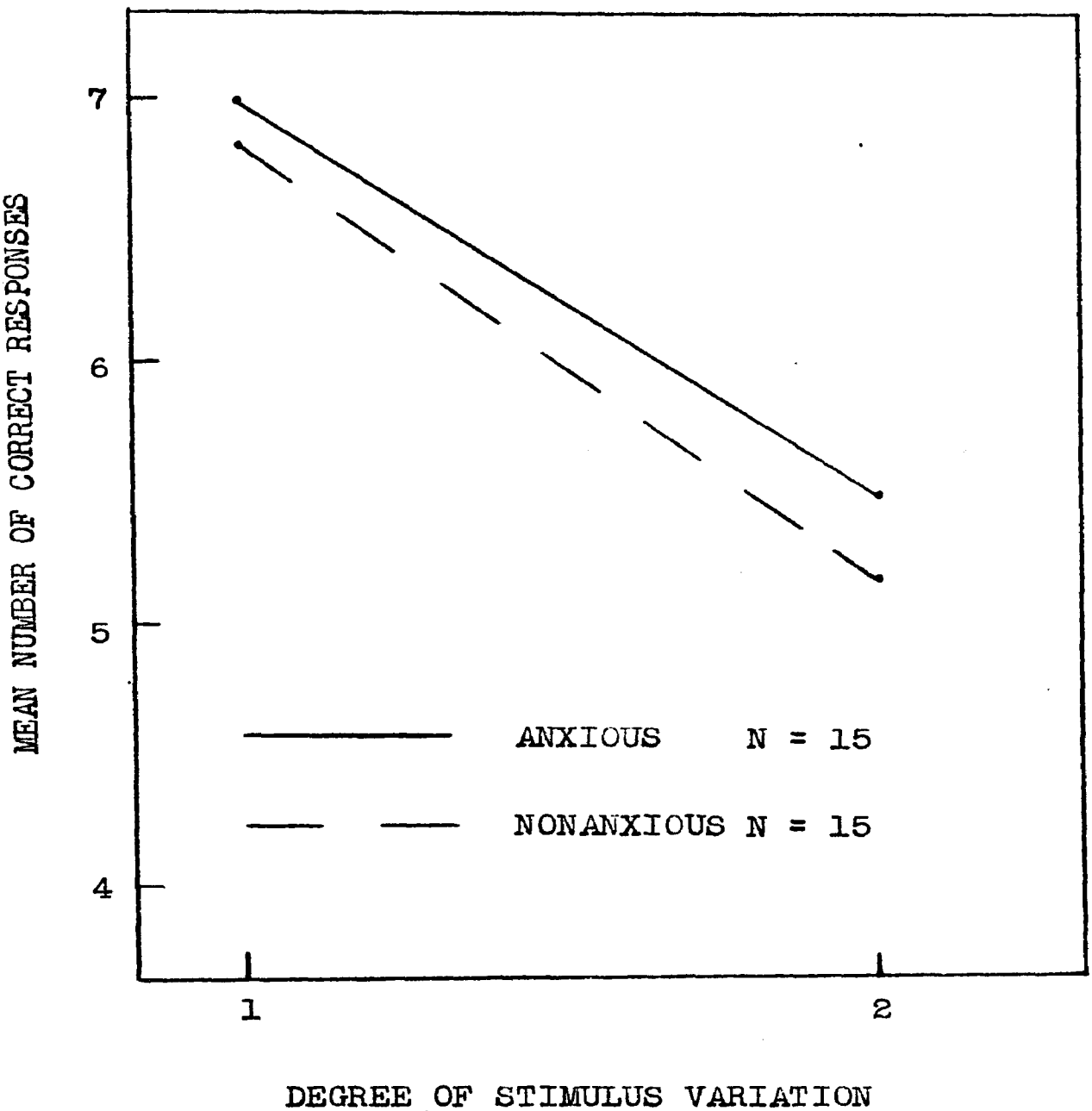

Figure 7. Performance curves from the Individual Experiment, Positive Transfer. The two points on the curves represent the mean number of correct responses given by the anxious and nonanxious subjects to the stimulus figures varied one and two degrees of similarity during trials 1-3 of the positive transfer condition.

that the groups closely approximated each other in the number of correct responses to the altered forms on Trials 1-3 of the transfer situation and in the number of trials necessary to achieve the learning criterion of one errorless trial. Analyses of variance (Tables XVII and XVIII of Appendix D) support this observation of no difference in positive transfer between the two groups. Thus, hypotheses 4 and 5 were not confirmed in this situation.

It should be noted in Figure 7 that there is a real gradient of stimulus generalization based upon Gibson's (4) classification of the altered stimulus figures into those of first- and those of second-degree similarity. However, the obtained gradient is a joint function of this similarity dimension and the degree to which the responses to the two sets of four standard figures were originally learned. Presumably, the effect of the latter variable has been to flatten the gradient by lowering the amount of generalization to the stimulus figures of first-degree similarity, inasmuch as the verbal responses to the standard figures corresponding to the first-degree figures were better learned in the original learning situation. This interpretation is in keeping with the finding of less generalization by the superior learners in the group

experiment of the present study and with Gibson's (4) previously mentioned findings of a decrease in stimulus generalization as learning continues.

Negative Transfer:

Figure 8 graphically records the obtained results of the negative transfer condition on the performance of the 20 anxious and 20 nonanxious subjects who participated in it. Table V also presents a summary of these findings. Inspection of these data reveals that the two groups differ markedly in the number of correct responses made to the stimulus figures of first- and second-degree similarity during trials 1-10 of the transfer situation. At each of the two points along the similarity continuum the anxious subjects are clearly superior in performance. Also, the extent of the superiority of the anxious group tends to remain about the same at both points. Thus, the expectations of hypotheses 6 and 7, that the anxious subjects would give more correct new responses to the similar stimuli than the nonanxious and that this difference would be the same for each variation of the stimulus figures, were realized.

The results of several statistical tests confirm the above observations. First, an analysis of variance of

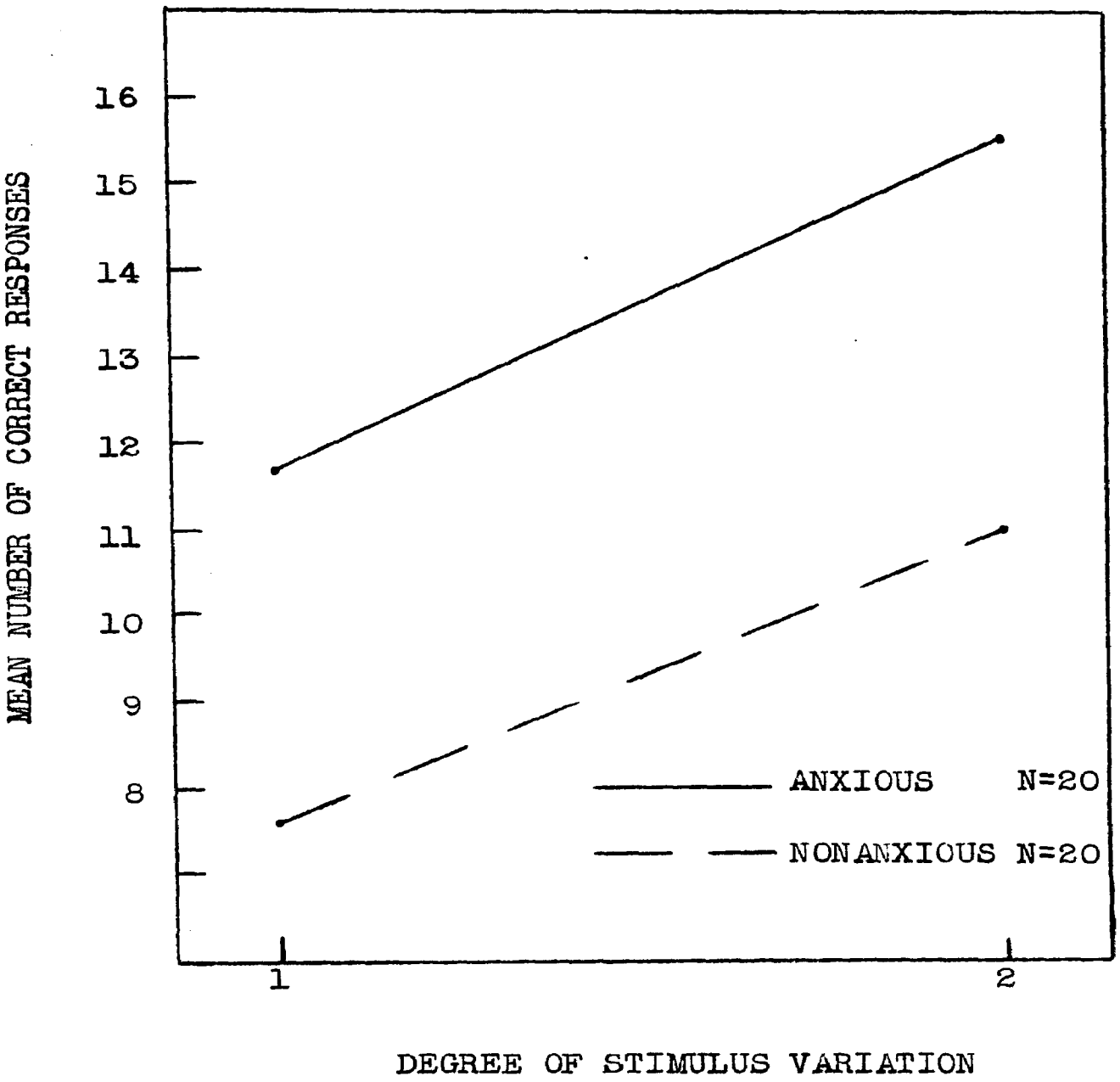

Figure 8. Performance curves from the Individual Experiment, Negative Transfer. The points on the curves represent the mean number of correct responses given by the anxious and nonanxious subjects to the stimulus figures varied one and two degrees of similarity during trials 1 to 10 of the negative transfer condition.

the difference between the groups in trials to achieve the criterion during the original learning situation yielded no significant difference between the groups in rate of learning (Table XX, Appendix D). The result of this analysis is thus consistent with the analysis of the total group of anxious and nonanxious subjects as reported earlier. However, to control for the effect of whatever difference did exist in the rate of original learning and then to test the differences in number of correct responses to the altered stimuli, an analysis of covariance was made. The results of this analysis are presented in Table XXI, Appendix D. The F ratio of 9.81 with 1 and 37 degrees of freedom is significant beyond the one percent level of confidence, indicating as was expected that the performance of the anxious group was clearly different from and superior to the nonanxious group. Two further analyses of variance were made to test the differences between the groups at each of the two points along the similarity continuum. These are reported in Tables XXII and XXIII of Appendix D. Each of these analyses yielded F ratios significant beyond the five percent level of confidence.

CHAPTER IV

DISCUSSION

The present study was designed as an empirical investigation of the hypothesis that the effect of increased anxiety upon performance under original learning and stimulus generalization conditions is, in part, a function of the presence of conditioned and unconditioned response tendencies associated with the anxiety drive-stimulus. It was conjectured that in a rote verbal learning situation the response tendencies associated with increased anxiety would interfere with the learning of verbal responses, the extent of such interference varying with the stimulus conditions and materials used. However, the principal hypothesis was concerned with the effect of these incompatible responses in a stimulus generalization situation in which the effective strength of previously learned verbal responses to stimuli similar to the original stimuli is tested. Under this condition it was predicted that the anxiety response tendencies would compete with the generalized verbal response tendencies and thus reduce their effective strength.

The results of the recognition memory group experiment support the above hypothesis. Although in Part I of the group experiment it was found that level of anxiety does not differentially affect the recognition learning scores, this finding can be readily accounted for. If we assume that the anxious subjects learn more slowly during the early learning trials because of the competition of the anxiety response tendencies and if we further assume that they accrue greater increments of verbal response tendency throughout learning, it is possible in the limited number of trials given the subjects, that these two opposite effects cancel each other, thus maintaining the performance of the anxious subjects at the same level as that of the nonanxious subjects. It is also possible to interpret the lack of any difference between the groups as meaning that the group experimental setting was not particularly threatening to the anxious subjects and, as a result, the anxiety drive was not operative. However, this interpretation does not seem likely in view of the results of Part II of the group experiment. Though the learning situation of Part II is almost identical to that of Part I, when tested for generalization there is a significant difference between the anxious and nonanxious subjects in the mean number of recognition responses made to the

altered nonsense words (c.f., Figure IV, page 52). On the basis of this result we presume that the performance measure of learning of the original words in Part I reflected both the interfering and facilitating effects of anxiety and that the influence of the response tendencies associated with anxiety did not become apparent until the test for generalization was made. In the generalization situation, the effective strength of the generalized response tendencies for the anxious subjects was uniformly reduced along the stimulus similarity continuum and, as a result, fewer responses to the changed words were made.

The results of the original learning in the individual experiments seem to emphasize the facilitating effects of anxiety as a drive rather than the interfering effects of anxiety-induced responses. Here it was found that, although there is no significant difference in the number of trials to reach the criterion of one perfect trial, the anxious subjects show a trend to achieve the criterion faster than the nonanxious subjects and, except for the very first response, they produce each successive first response to the figures from 1.07 to 3.94 trials sooner than the non-anxious group.

The results of the positive transfer experiment fail to yield any differences or trends which might clearly

confirm or refute the theoretical analysis of this situation. There are several possible explanations for this outcome. One of these is that the positive transfer list was so easy (each group took a mean of about 6 trials to learn the list) that the measures of learning used were too gross to reflect the differential effect of anxiety upon generalization. Another equally reasonable interpretation of the lack of difference between the groups under positive transfer conditions stems from the nature of the positive transfer situation as compared with the negative transfer situation. In the positive transfer experiment not only were the stimulus figures similar to those used in the original learning situation but the corresponding response syllables were identical. This contrasts with the negative transfer situation in which the figures were similar but the response syllables were entirely new and different. It could very well be that the two different situations, one easy and familiar and the other difficult and relatively unfamiliar, elicited differential amounts of anxiety in the anxious subjects. In the positive transfer situation little activation of the anxiety drive state, even in anxious subjects, may have taken place; in fact, the anxiety drive could conceivably have been less than in the original learning situation. In the negative transfer situation,

however, the difficulty of the task may even have resulted in an increase in the anxiety state. Thus, the failure to obtain a difference between groups in the positive transfer situation not only seems reasonable, under post hoc considerations, but congruent with the theory. In the negative transfer situation the expectation that the anxious subjects would produce more correct responses to the similar stimulus figures was confirmed. The theoretical basis for this result is that the strength of the generalized response tendencies that were originally correct and are now incorrect has been reduced because of anxiety-induced response competition. Consequently, interference in learning the new response is reduced and the performance of the anxious subjects is enhanced.

It is of some importance to note that the theoretical basis of the present experiment provides a reasonable explanation of the results of Montague (17) which were discussed in the Introduction. He utilized three rote serial learning tasks which represented three gradations on a continuum of difficulty. He found that the anxious subjects obtained scores considerably lower than those of the nonanxious subjects on the most difficult list. On the list of median difficulty, mean scores for the anxious group were only slightly below those for the nonanxious

group. On the easiest list the anxious subjects were superior in performance. If we assume that the difficulty of the three tasks elicited differential amounts of anxiety and that the differences in drive were relatively greater for the anxious subjects, then we would expect the obtained results on the basis of the present formulation. The difficult task would presumably arouse the greatest amount of anxiety and anxiety-induced response competition in the anxious subjects and they would perform more poorly than the nonanxious subjects. The task of median difficulty elicited fewer anxiety-induced responses in the anxious subjects and, as in the original learning situation of the present individual experiments, the interfering effects of anxiety response competition may have been approximately counterbalanced by the facilitating effects of drive on reaction potential. In the easy task, the fewest number of incompatible anxiety-induced responses are elicited and the higher manifest anxiety level served to facilitate the performance of the anxious subjects.

This analysis brings up a point which has not been fully elaborated in the previous discussion, namely, the relationship between the facilitating and interfering effects of anxiety as the level of anxiety is raised. Here it is assumed that, with any elevation of anxiety,

there is both an increase in number and in strength of anxiety response tendencies with a concomitant retardation of the learning of verbal responses. It is also assumed that greater facilitation of verbal learning (greater increments of the verbal reaction tendency) may occur with elevation of anxiety, but this facilitation does not increase at a rate commensurate with the interference effect of the competing anxiety-induced response tendencies. In other words, anxiety as an additional irrelevant drive state at a low level, may facilitate verbal learning, but as the level is raised there is a point above which anxiety will interfere with the verbal learning process.

CHAPTER V

SUMMARY

The present experiment is an investigation of the hypothesis that the effect of increased anxiety is, in part, a function of the presence of conditioned and unconditioned response tendencies associated with the anxiety drive-stimulus.

Anxiety is considered as a drive possessing certain functional characteristics similar to other drive states, namely, that increased drive increases the strength of all response tendencies capable of being evoked in a situation and augments each accrued increment of reaction potential. Anxiety as a stimulus, like other drive conditions, also evokes various conditioned and unconditioned responses which vary in strength according to the level of the drive.

Largely on the basis of this latter assumption, the following general hypothesis is proposed. In a stimulus generalization situation in which the effective strength of generalized verbal responses to altered stimuli is tested, the response tendencies associated with anxiety will compete with the generalized response tendencies

more in the anxious than the nonanxious group. Thus, the subjects high in anxiety will show a lower and steeper gradient of generalization, less positive transfer, and less negative transfer than those subjects low in anxiety.

Level of anxiety was determined by means of high and low scores on a questionnaire designed to measure manifest anxiety. Thirty-two anxious and thirty-two nonanxious subjects, who were selected on the basis of the anxiety scale and matched on the basis of an independent recognition measure of learning, participated in a group recognition memory situation. Two other paired groups of anxious and nonanxious subjects, each of whom was selected independently of the others on the basis of the anxiety scale, participated individually in positive and negative transfer situations. There were fifteen anxious and fifteen nonanxious subjects in the positive transfer situation and twenty anxious and twenty nonanxious subjects in the negative transfer situation.

In line with our hypothesis, the results of the group recognition memory experiment show that the anxious subjects respond significantly less often to the altered stimuli than the nonanxious subjects, after showing no difference in original learning. In the original learning situation of the transfer experiments the anxious subjects

show a definite tendency to learn more rapidly. In the positive transfer situation, after both groups achieve the same criterion of original learning, the performance of the anxious and nonanxious subjects is the same. But in the negative transfer situation the anxious subjects show the predicted drop in amount of stimulus generalization by making significantly more correct new responses to the altered stimuli than the nonanxious subjects.

The present findings point up the necessity of including the response-evoking aspects of anxiety in any interpretation of behavior which employs anxiety as a drive.

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APPENDIX A

BIOGRAPHICAL INVENTORY*

Do not write or mark on this booklet in any way. Your answers to the statements in this inventory are to be recorded only on the separate Answer Sheet.

Print your name, the date, the date of your birth, age, sex, etc., in the blanks provided on the Answer Sheet. Use only the special pencil provided for this test; this pencil must be used because the Answer Sheet will be checked by a machine. If your special pencil runs out of lead, get another pencil from the Examiner. Do not use any other type of pencil. After you have completed filling in the blanks, finish reading these instructions.

The statements in this booklet represent experiences, ways of doing things, or beliefs or preferences that are true of some people but are not true of others. You are to read each statement and decide whether or not it is true with respect to yourself. If it is true or mostly true, blacken the answer space in column T on the Answer Sheet in the row numbered the same as the statement you are answering. If the statement is not usually true or is not true at all, blacken the space in column F in the numbered row. You must answer the statement as carefully and honestly as you can. There are no correct or wrong answers: we are interested in the way you work and in the things you believe.

Remember: Mark the answer space in column T if the statement is true or mostly true; mark the answer space in column F if the statement is false or mostly false. Be sure the space you blacken is in the row numbered the same as the item you are answering. Use only the first two columns, the ones labeled T and F. Mark each item as you come to it; be sure to mark one, and only one, answer space for each item. Here is an example:

	T		F	
I would like to be an artist.	:	:	:	:

*Anxiety items are marked by an asterisk.

If you <u>would</u> like to be an artist, that is, if the statement is true as far as you are concerned, you would mark the answer space under <u>T</u>. If the statement is false, you would mark the space under <u>F</u>.

If you have any questions, please ask them now.

DO NOT MARK ON THIS BOOKLET

1. I would rather win than lose in a game.
2. I am often the last one to give up trying to do a thing.
3. There is usually only one best way to solve most problems.
×4. I do not tire quickly.
5. I am troubled by attacks of nausea.
6. I am in just as good physical health as most of my friends.
×7. I believe I am no more nervous than most others.
8. I think that I feel more intensely than most people do.
9. I have had periods in which I carried on activities without knowing later what I had been doing.
10. There is something wrong with my mind.
×11. I have very few headaches.
12. My hearing is apparently as good as that of most people.
×13. I work under a great deal of tension.
×14. I cannot keep my mind on one thing.
15. I do not like everyone I know.
×16. I worry over money and business.
17. I think a great many people exaggerate their misfortunes in order to gain the sympathy and help of others.
×18. I frequently notice my hand shakes when I try to do something.
19. I prefer work that requires a great deal of attention to detail.
20. My neck spots with red often.

(Go right on to the next page.)

21. I seem to be about as capable and smart as most others around me.

22. I have a cough most of the time.

23. I often become so wrapped up in something I am doing that I find it difficult to turn my attention to other matters.

× 24. I blush no more often than others.

25. I have diarrhea once a month or more.

× 26. I worry quite a bit over possible misfortunes.

× 27. I practically never blush.

28. I have very few quarrels with members of my family.

29. I think nearly anyone would tell a lie to keep out of trouble.

30. I am against giving money to beggars.

31. Once in a while I put off until tomorrow what I ought to do today.

32. I can sleep during the day but not at night.

× 33. I am often afraid that I am going to blush.

34. I cannot understand what I read as well as I used to.

35. I have nightmares every few nights.

× 36. My hands and feet are usually warm enough.

37. I sweat very easily even on cool days.

× 38. Sometimes when embarrassed, I break out in a sweat which annoys me greatly.

39. I have been told that I walk during sleep.

40. I am almost never bothered by pains over the heart or in my chest.

(Go right on to the next page.)

×41. I hardly ever notice my heart pounding and I am seldom short of breath.

42. I have used alcohol excessively.

×43. I feel hungry almost all the time.

×44. I am very seldom troubled by constipation.

45. I like to know some important people because it makes me feel important.

×46. I find it hard to make talk when I meet new people.

×47. People often disappoint me.

48. I have a great deal of stomach trouble.

49. I prefer doing one thing at a time to keeping several projects going.

50. My parents and family find more fault with me than they should.

×51. I have had periods in which I lost sleep over worry.

52. I dislike to change my plans in the midst of an undertaking.

53. I wake up fresh and rested most mornings.

54. My sleep is fitful and disturbed.

55. I have reason for feeling jealous of one or more members of my family.

×56. I dream frequently about things that are best kept to myself.

57. I love my mother.

×58. Some of my family have habits that bother and annoy me very much.

59. It makes me impatient to have people ask my advice or otherwise interrupt me when I am working on something important.

(Go right on to the next page.)

60. I find it hard to set aside a task that I have undertaken, even for a short time.

61. My table manners are not quite as good at home as when I am out in company.

62. My mother is a good woman.

63. Most nights I go to sleep without thoughts or ideas bothering me.

64. I love my father.

65. I never miss going to church.

×66. I am easily embarrassed.

×67. I am more sensitive than most other people.

68. My father is a good man.

69. My people treat me more like a child than a grown-up.

70. I would like a position which requires frequent changes from one kind of task to another.

71. I usually maintain my own opinions even though many other people may have a different point of view.

72. Once in a while I feel hate towards members of my family whom I usually love.

73. I usually expect to succeed in things I do.

×74. I easily become impatient with people.

75. If I could get into a movie without paying and be sure I was not seen I would probably do it.

76. It makes me uncomfortable to put on a stunt at a party even when others are doing the same sort of thing.

×77. I frequently find myself worrying about something.

78. I often worry about my health.

(Go right on to the next page.)

79. My family does not like the work I have chosen (or the work I intend to choose for my life work).

80. I like to study and read about things that I'm working at.

81. The only interesting part of newspapers is the "funnies".

×82. I wish I could be as happy as others seem to be.

×83. I am usually calm and not easily upset.

84. My sex life is satisfactory.

85. I find it easy to stick to a certain schedule, once I have started on it.

×86. I cry easily.

×87. I feel anxiety about something or someone almost all of the time.

88. Children should be taught all the main facts of sex.

89. Criticism or scolding hurts me terribly.

90. It takes a lot of argument to convince most people of the truth.

91. I do not read every editorial in the newspaper every day.

92. I wish I were not bothered by thoughts of sex.

93. I am very religious (more than most people).

×94. I am happy most of the time.

95. I believe women ought to have as much sexual freedom as man.

96. I believe there is a God.

97. I believe in a life hereafter.

98. A minister can cure disease by praying and putting his hand on your head.

(Go right on to the next page.)

× 99. It makes me nervous to have to wait.

×100. I have periods of such great restlessness that I cannot sit long in a chair.

101. I frequently find it necessary to stand up for what I think is right.

102. I do not enjoy having to adapt myself to new and unusual situations.

×103. Sometimes I become so excited that I find it hard to get to sleep.

104. My soul sometimes leaves my body.

105. Sometimes when I am not feeling well I am cross.

106. At times I am all full of energy.

×107. I have sometimes felt that difficulties were piling up so high that I could not overcome them.

×108. At times I have a strong urge to do something harmful or shocking.

109. I prefer to stop and think before I act even on trifling matters.

110. I am liked by most people who know me.

×111. Sometimes I am sure that other people can tell what I am thinking.

×112. I must admit that I have at times been worried beyond reason over something that really did not matter.

113. As a youngster I was suspended from school one or more times for cutting up.

114. No one seems to understand me.

115. I would not like the kind of work which involves a large number of different activities.

(Go right on to the next page.)

116. I try to follow a program of life based on duty.

x 117. I have very few fears compared to my friends.

118. I refuse to play some games because I am not good at them.

119. I often think "I wish I were a child again".

120. Often I can't understand why I have been so cross and grouchy.

121. At times I feel like swearing.

122. More often than others seem to, I do many things that I regret afterwards.

x 123. I have been afraid of things or people that I know could not hurt me.

124. I believe in law enforcement.

125. I have kept a careful diary over a period of years.

126. I wish I were not so shy.

127. It would be better if almost all laws were thrown away.

128. My interests tend to change quickly.

129. I enjoy children.

130. I usually find that my own way of attacking a problem is best, even though it doesn't always seem to work in the beginning.

131. I am never happier than when alone.

132. Even when I am with people I feel lonely most of the time.

x 133. I am afraid when I look down from a high place.

134. At times I feel like smashing things.

135. I get angry sometimes.

x 136. I certainly feel useless at times.

(Go right on to the next page.)

137. At periods my mind seems to work more slowly than usual.

× 138. I find it hard to keep my mind on a task or job.

139. Most any time I would rather sit and day dream than to do anything else.

140. I have difficulty in starting to do things.

141. I dislike having to learn new ways of doing things.

142. I like a great deal of variety in my work.

143. I brood a great deal.

144. Most of the time I feel blue.

145. I am unusually self-conscious.

146. I have the wanderlust and am never happy unless I am roaming or traveling about.

147. At times it has been impossible for me to keep from stealing or shoplifting something.

148. I am a methodical person in whatever I do.

149. I have often met people who were supposed to be experts who were no better than I.

150. What others think of me does not bother me.

151. Once in a while I laugh at a dirty joke.

× 152. I am inclined to take things hard.

× 153. I am a high-strung person.

154. Sometimes I feel as if I must injure either myself or someone else.

155. I have not lived the right kind of life.

156. I certainly have had more than my share of things to worry about.

(Go right on to the next page.)

157. If people had not had it in for me I would have been much more successful.

158. I am usually able to keep at a job longer than most people.

159. I believe I am being followed.

160. I think it is usually wise to do things in a conventional way.

161. I always finish tasks I start, even if they are not very important.

162. Someone has been trying to influence my mind.

× 163. Life is a strain for me much of the time.

× 164. At times I think I am no good at all.

165. I do not always tell the truth.

166. I have never felt better in my life than I do now.

167. Most people will use somewhat unfair means to gain profit or an advantage rather than to lose.

× 168. I am certainly lacking in self-confidence.

169. Someone has control over my mind.

170. People who go about their work methodically are almost always the most successful.

171. I sometimes keep on at a thing until others lose their patience with me.

172. At one or more times in my life I felt that someone was making me do things by hypnotizing me.

173. When I have undertaken a task, I find it difficult to set it aside, even for a short time.

174. I believe I am being plotted against.

(Go right on to the next page.)

175. Sometimes unimportant thoughts will run through my mind and bother me for days.

176. Often I cross the street in order not to meet someone I see.

177. Someone has been trying to poison me.

178. Someone has been trying to rob me.

179. I often find myself thinking of the same tune or phrase for days at a time.

180. I like to let people know where I stand on things.

181. I gossip a little at times.

182. I have a work and study schedule which I follow carefully.

× 183. I sometimes feel that I am about to go to pieces.

184. There are persons who are trying to steal my thoughts and ideas.

185. I often feel as if things were not real.

186. I usually check more than once to be sure that I have locked a door, put out the light, or something of the sort.

× 187. I shrink from facing a crisis or difficulty.

188. I commonly hear voices without knowing where they come from.

189. I am sure I am being talked about.

× 190. I am entirely self-confident.

191. I have never done anything dangerous for the thrill of it.

192. When I am with people I am bothered by hearing very queer things.

193. I commonly wonder what hidden reason another person may have for doing something nice for me.

(Go right on to the next page.)

194. It is always a good thing to be frank.

195. Once in a while I think of things too bad to talk about.

196. When in a group of people I have trouble thinking of the right things to talk about.

197. I get mad easily and get over it soon.

198. I see things or animals or people around me that others do not see.

199. Evil spirits possess me at times.

200. I have a lot more fears than my friends do.

201. I like to visit places where I have never been before.

202. At times I am afraid of losing my mind.

203. I am not afraid to handle money.

204. Sometimes I enjoy hurting persons I love.

205. I can easily make other people afraid of me, and sometimes do for the fun of it.

206. I have a habit of collecting various kinds of objects.

207. It does not bother me particularly to see animals suffer.

208. Sometimes I am strongly attracted by the personal articles of others such as shoes, gloves, etc., so that I want to handle or steal them though I have no use for them.

209. I have periods in which I feel unusually cheerful without any special reason.

210. At times my thoughts have raced ahead faster than I could speak them.

211. Sometimes at elections I vote for men about whom I know very little.

212. I have more trouble concentrating than other people seem to have.

(Go right on to the next page.)

213. Everything tastes the same.

214. I have taken a good many courses on the spur of the moment.

215. No one cares much what happens to you.

216. I believe that promptness is a very important personality characteristic.

217. My interests change very quickly.

218. My way of doing things is apt to be misunderstood by others.

219. It is the slow, steady worker who usually accomplishes the most in the end.

220. I am always careful about my manner of dress.

221. Any man who is able and willing to work hard has a good chance of succeeding.

222. I usually dislike to set aside a task that I have undertaken until it is finished.

223. I am inclined to go from one activity to another without continuing with any one for too long a time.

224. I prefer to do things according to a routine which I plan myself.

225. I always put on and take off my clothes in the same order.

STOP HERE

APPENDIX B

PROCEDURE USED FOR ESTABLISHING THE VALIDITY OF THE PART I RECOGNITION SCORES OF THE GROUP EXPERIMENT AS A MEASURE OF LEARNING PRIOR TO THE TEST FOR GENERALIZATION IN PART II OF THE GROUP EXPERIMENT

Inasmuch as the experimental hypotheses were such that it was desirable to equate the anxious and nonanxious subjects, on a performance measure of learning prior to the test for generalization, the learning list and recognition test of Part I of the group experiment were developed. The details of their construction have been described on pages 30-31 It was assumed that if scores on that recognition test could be shown to have a high correlation with a score on a similarly constructed recognition test of the Part II learning list, then the Part I recognition test scores could be used as a basis for matching anxious and nonanxious subjects for learning prior to the Part II generalization condition. Therefore, in addition to the Part I learning list and recognition test, a recognition test which contained the 24 nonsense words of the Part II learning list unchanged and 24 new and unrelated nonsense words was constructed.[1]

To secure a measure of the relationship between the scores on the two recognition tests, a group of 60 high school seniors (having age, sex, and other characteristics

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[1] These words were originally constructed by Postman (18).

similar to the group of college students who participated in the foregoing experiments) were presented with the learning trials and recognition Test of Part I of the Recognition Memory Experiment in the manner described on pages 31-33 of this paper. On the following day the same group was given the learning Trials of Part II of the experiment after which they were presented recognition tests containing a random arrangement of the 24 unchanged nonsense words and 24 unrelated nonsense words. They were asked to indicate on a record sheet their choices of the 24 words which had been presented to them on the screen.

When the scores on the two recognition tests were correlated, a coefficient of .78 was obtained. It indicates that there is some basis for the assumption that the scores achieved on the Part I Recognition Test can be used for the purpose of matching groups on original learning for Part II of the Recognition Memory experiment.

APPENDIX C

LISTS OF THE NONSENSE SYLLABLES AND WORDS USED IN THE GROUP EXPERIMENT

Recognition Memory Part I, Learning and Recognition:*

1.	QID	15.	NUK	29.	GED	43.	LEQ
2.	JAT	16.	XEV	30.	KAZ	44.	BUQ
3.	VUZ	17.	YOT	31.	ZEY	45.	VAK
4.	CUJ	18.	KIG	32.	XUG	46.	JUF
5.	VYT	19.	NAX	33.	GOK	47.	LUY
6.	YUB	20.	HYZ	34.	DYW	48.	PAF
7.	MOX	21.	NOJ	35.	ZAW	49.	HEG
8.	JEC	22.	SYJ	36.	POH	50.	RIX
9.	ZOR	23.	BIP	37.	FEP	51.	TUV
10.	YIC	24.	LIW	38.	DEJ	52.	GUH
11.	DAQ	25.	XAP	39.	SIH	53.	SEB
12.	CEX	26.	RYQ	40.	MUW	54.	QEF
13.	WOS	27.	QUS	41.	BEH	55.	TYF
14.	FOQ	28.	MYB	42.	GIC	56.	WUP

*The learning syllables are underlined.

Recognition Memory, Part II, Learning:

1.	BAZWAP	7.	GAXVEP	13.	KOGYAH	19.	SAJMOJ
2.	CEBQUS	8.	GIDVOR	14.	MEYBIP	20.	TEFZOK
3.	CIZPEM	9.	GYKWUT	15.	MYPJEC	21.	VUDHYF
4.	DACTUV	10.	HEJYOF	16.	QENCUX	22.	WOZVAK
5.	DEHKEZ	11.	HUZLUJ	17.	RIJKAF	23.	YINGUB
6.	FOVJAT	12.	JYTQAM	18.	RUKNYB	24.	YUCFUP

Recognition Memory, Part II, Recognition:*

Test I

1.	GANDOP (3)	7.	DAJMOJ (1)	13.	MIGQUS (3)	19.	VYGHYF (2)
2.	MEYBIP (0)	8.	KOVFIH (3)	14.	YUCQOP (2)	20.	FAWZOK (3)
3.	MYPWYD (3)	9.	YILGUB (1)	15.	BYZWAP (1)	21.	COHKEZ (2)
4.	QENCUX (0)	10.	RALCYB (3)	16.	GYKSUT (1)	22.	DACTYV (1)
5.	RIJKAF (0)	11.	HUZLUJ (0)	17.	FOQZAT (2)	23.	GIDVIB (2)
6.	HEJYOF (0)	12.	CIZPEX (1)	18.	WEQVAK (2)	24.	JYTQAM (0)

Test II

1.	GAXVEP (0)	7.	LYJMOJ (2)	13.	CEBQUS (0)	19.	VUDHYR (1)
2.	MEYPYX (3)	8.	KOGYAH (0)	14.	YUCNUP (1)	20.	TEFZOK (0)
3.	MYPJEC (0)	9.	YILMUB (2)	15.	BYVWAP (2)	21.	VEHKEZ (1)
4.	ZURCUX (3)	10.	RUKNYB (0)	16.	CYKFET (2)	22.	DACTYS (2)
5.	RIKBUF (3)	11.	HIFKUJ (3)	17.	FOQJAT (1)	23.	GIDVIR (1)
6.	HEJQIX (3)	12.	KYZPEM (2)	18.	WYZVAK (1)	24.	JYTLER (3)

Test III

1.	GANREP (2)	7.	LYGMOJ (3)	13.	MIBQUS (2)	19.	VUDHYF (0)
2.	MEYBIX (1)	8.	KYMYAH (2)	14.	YUCFUP (0)	20.	TEFZIS (2)
3.	MYPWYC (2)	9.	YILPOB (3)	15.	BYVZAP (3)	21.	DEHKEZ (0)
4.	QONCUX (1)	10.	RUHCYB (2)	16.	GYKFEG (3)	22.	JUFTUV (3)
5.	RIJKIF (1)	11.	KUZLUJ (1)	17.	FOVJAT (0)	23.	GIDVOR (0)
6.	HEJDOF (1)	12.	COHBEM (3)	18.	WOZVAK (0)	24.	ZYXQUM (1)

Test IV

1.	GANVEP (1)	7.	SAJMOJ (0)	13.	GEBQUS (1)	19.	VUDFEX (3)
2.	MEYBER (2)	8.	KUGYAH (1)	14.	YUCQOS (3)	20.	TEFZIK (1)
3.	MYPWEC (1)	9.	YINGUB (0)	15.	BAZWAP (0)	21.	BYSKEZ (3)
4.	ZUNCUX (2)	10.	RUKNYJ (1)	16.	GYKWUT (0)	22.	DACTUV (0)
5.	RIJKYX (2)	11.	HARLUJ (2)	17.	FOQZET (3)	23.	GICKIR (3)
6.	HEJDIF (2)	12.	CIZPEM (0)	18.	WYQCAK (3)	24.	JYCNAM (2)

*The extent of the change in composition is indicated in parenthesis after each word.

TABLES OF THE NONSENSE SYLLABLES AND FIGURES USED IN THE INDIVIDUAL EXPERIMENTS

TABLE VI.

THE PAIRED-ASSOCIATE UNITS USED IN THE ORIGINAL LEARNING SITUATION OF THE INDIVIDUAL EXPERIMENTS

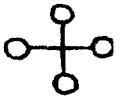
Standard Stimulus Figures For Lists 1 and 2	Degree of Similarity of Corresponding Figures Found in Tables VII and VIII	Response Syllables	
		List 1	List 2
	1	MIF	POG
	1	QAP	BOF
	1	ZEJ	KEB
	1	GUK	JID
	2	POG	MIF
	2	BOF	QAP
	2	KEB	ZEJ
	2	JID	GUK

TABLE VII

THE PAIRED-ASSOCIATE UNITS USED IN THE POSITIVE TRANSFER SITUATION OF THE INDIVIDUAL EXPERIMENTS

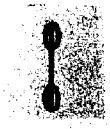
Altered Stimulus Figures For Lists 1 and 2	Degree of Similarity to Standard Figures of Table [illegible]	Response Syllables	
		List 1	List 2
	1	MIF	POG
	1	QAP	BOF
	1	ZEJ	KEB
	1	GUK	JID
	2	POG	MIF
	2	BOF	QAP
	2	KEB	ZEJ
	2	JID	GUK

TABLE VIII

THE PAIRED-ASSOCIATE UNITS USED IN THE NEGATIVE TRANSFER SITUATION OF THE INDIVIDUAL EXPERIMENTS

Altered Stimulus Figures For Lists 1 and 2	Degree of Similarity to Standard Figures of Table VI	Response Syllables	
		List 1	List 2
	1	LAJ	ZUF
	1	GIX	PYB
	1	NUX	YEK
	1	FEH	CEF
	2	ZUF	LAJ
	2	PYB	GIX
	2	YEK	NUX
	2	CEF	FEH

APPENDIX D

ANALYSES OF VARIANCE AND COVARIANCE TABLES

TABLE IX

ANALYSIS OF VARIANCE OF DATA FROM THE GROUP EXPERIMENT, PART II, RECOGNITION. COMPARISON OF THE RESPONSES TO THE ORIGINAL AND CHANGED NONSENSE WORDS OF 32 HIGH- AND 32 LOW-ANXIETY SUBJECTS

Source of Variation	DF	Mean Square
Between Subjects	63	1.49
High vs. Low Anxiety	1	8.23
Within	62	1.38
Within Subjects	192	2.98
Change of Composition (0-3)	3	108.02
Interaction: High vs. Low Anxiety X Change of Composition (0-3)	3	.66
Interaction: Pooled Subjects X Change of Composition (0-3)	186	1.33
Total	255	2.62

VARIANCE RATIOS

F*	$\frac{\text{Interaction: High vs. Low Anxiety X Change of Composition}}{\text{Interaction: Pooled Subjects X Change of Composition}}$	= .50	*.05 level, F = 2.65
F**	$\frac{\text{Change of Composition}}{\text{Interaction: Pooled Subjects X Change of Composition}}$	= 81.50	**.01 level, F = 3.89
F***	$\frac{\text{High vs. Low Anxiety}}{\text{Within}}$	= 5.97	***.05 level, F = 4.00; .01 level, F = 7.08

TABLE X

ANALYSIS OF VARIANCE OF DATA FROM THE GROUP EXPERIMENT, PART II, RECOGNITION. COMPARISON OF THE RESPONSES TO THE CHANGED WORDS OF 48 SUBJECTS 24 OF WHOM ACHIEVED PART I RECOGNITION SCORES OF 14-19 AND 24 OF WHOM ACHIEVED PART I RECOGNITION SCORES OF 25-28

Source of Variation	DF	Mean Square	F*
Between	1	18.07	7.93
Within	46	2.28	
Total	47	2.61	

*.05 level, F = 4.05; at .01 level, F = 7.21

TABLE XI

ANALYSIS OF VARIANCE OF DATA FROM THE INDIVIDUAL EXPERIMENTS COMPARISON OF 45 HIGH- AND 45 LOW-ANXIETY SUBJECTS FOR NUMBER OF TRIALS TO LEARN IN THE ORIGINAL LEARNING SITUATION

Source of Variation	DF	Mean Square	F*
Between	1	41.30	.23
Within	88	181.66	
Total	89	178.96	

*.05 level, F = 3.95

TABLE XII

ANALYSIS OF COVARIANCE AND TEST OF SIGNIFICANCE OF ADJUSTED GROUP MEANS FOR THE INDIVIDUAL EXPERIMENTS. ORIGINAL LEARNING COMPARISON OF 45 HIGH- AND 45 LOW-ANXIETY SUBJECTS FOR NUMBER OF CORRECT RESPONSES GIVEN DURING ORIGINAL LEARNING AFTER ADJUSTING THE NUMBER OF CORRECT RESPONSES TO A COMMON TRIALS-TO-LEARN BASIS

Source of Variation	DF	Mean Square	F*
Between	1	371.50	.68
Within	87	549.58	
Total	88	547.56	

*.05 level, F = 3.95

TABLE XIII

ANALYSIS OF VARIANCE OF DATA FROM THE INDIVIDUAL EXPERIMENTS, ORIGINAL LEARNING. COMPARISON OF THE 45 HIGH- AND 45 LOW-ANXIETY SUBJECTS FOR FIRST CORRECT RESPONSES TO THE EIGHT STANDARD FIGURES

Source of Variation	DF	Mean Square	F*
Between	1	731.43	3.67
Within	88	200.11	
Total	89	207.81	

*.05 level, F = 3.95

TABLE XIV

ANALYSIS OF VARIANCE OF DATA FROM THE INDIVIDUAL EXPERIMENTS. COMPARISON OF 45 HIGH- AND 45 LOW-ANXIETY SUBJECTS FOR NUMBER OF CORRECT RESPONSES IN THE ORIGINAL LEARNING SITUATION TO THE STANDARD FIGURES LATER VARIED TO FIRST-DEGREE SIMILARITY

Source of Variation	DF	Mean Square	F*
Between	1	298.85	.46
Within	88	644.82	
Total	89	640.93	

*.05 level, F = 3.95

TABLE XV

ANALYSIS OF VARIANCE OF DATA FROM THE INDIVIDUAL EXPERIMENTS. COMPARISON OF 45 HIGH- AND 45 LOW-ANXIETY SUBJECTS FOR NUMBER OF CORRECT RESPONSES IN THE ORIGINAL LEARNING SITUATION TO THE STANDARD FIGURES LATER VARIED TO SECOND-DEGREE SIMILARITY

Source of Variation	DF	Mean Square	F*
Between	1	14.66	.03
Within	88	436.06	
Total	89	431.32	

*.05 level, F = 3.95

TABLE XVI

ANALYSIS OF VARIANCE OF DATA FROM THE INDIVIDUAL EXPERIMENTS. COMPARISON OF THE NUMBER OF CORRECT RESPONSES OF 90 HIGH- AND LOW-ANXIETY SUBJECTS TO THE STANDARD FIGURES LATER VARIED TO FIRST-DEGREE SIMILARITY AND TO THE STANDARD FIGURES LATER VARIED TO SECOND-DEGREE SIMILARITY

Source of Variation	DF	Mean Square	F*
Between	1	4312.00	8.04
Within	178	536.13	
Total	179	557.22	

*.01 level, F = 6.79

TABLE XVII

ANALYSIS OF VARIANCE OF DATA FROM THE POSITIVE TRANSFER EXPERIMENT. COMPARISON OF 15 HIGH- AND 15 LOW-ANXIETY SUBJECTS FOR NUMBER OF TRIALS TO LEARN THE TRANSFER LIST

Source of Variation	DF	Mean Square	F*
Between	1	.14	.01
Within	28	10.62	
Total	29	10.26	

*.05 level, F = 4.20

TABLE XVIII

ANALYSIS OF VARIANCE OF DATA
FROM THE POSITIVE TRANSFER EXPERIMENT.
COMPARISON OF 15 HIGH- AND 15 LOW-ANXIETY SUBJECTS
FOR NUMBER OF CORRECT RESPONSES
TO THE CHANGED FORMS OF FIRST-DEGREE SIMILARITY

Source of Variation	DF	Mean Square	F*
Between	1	.30	.12
Within	28	2.51	
Total	29	2.44	

*.05 level, F = 4.20

TABLE XIX

ANALYSIS OF VARIANCE OF DATA
FROM THE POSITIVE TRANSFER EXPERIMENT
COMPARISON OF 15 HIGH- AND 15 LOW-ANXIETY SUBJECTS
FOR NUMBER OF CORRECT RESPONSES
TO THE CHANGED FORMS OF SECOND-DEGREE SIMILARITY

Source of Variation	DF	Mean Square	F*
Between	1	.54	.20
Within	28	2.75	
Total	29	2.68	

*.05 level, F = 4.20

TABLE XX

ANALYSIS OF VARIANCE OF DATA
FROM THE NEGATIVE TRANSFER EXPERIMENT.
COMPARISON OF 20 HIGH- AND 20 LOW-ANXIETY SUBJECTS
FOR NUMBER OF TRIALS TO LEARN THE LIST
IN THE ORIGINAL LEARNING SITUATION

Source of Variation	DF	Mean Square	F*
Between	1	87.1	.47
Within	38	186.9	
Total	39	184.4	

*.05 level, F = 4.10

TABLE XXI

ANALYSIS OF COVARIANCE AND TEST OF SIGNIFICANCE
OF ADJUSTED GROUP MEANS, INDIVIDUAL EXPERIMENT,
NEGATIVE TRANSFER CONDITION.
COMPARISON OF 20 HIGH- AND 20 LOW-ANXIETY SUBJECTS
FOR THE NUMBER OF CORRECT RESPONSES
TO THE ALTERED STIMULUS FORMS

Source of Variation	DF	Mean Square	F*
Between	1	671.83	9.81
Within	37	68.51	
Total	38		

*.01 level, F = 7.39

TABLE XXII

ANALYSIS OF VARIANCE OF DATA
FROM THE NEGATIVE TRANSFER EXPERIMENT.
COMPARISON OF 20 HIGH- AND 20 LOW-ANXIETY SUBJECTS
FOR NUMBER OF CORRECT RESPONSES
TO THE CHANGED FORMS OF FIRST-DEGREE SIMILARITY

Source of Variation	DF	Mean Square	F*
Between	1	168.1	5.02
Within	38	33.5	
Total	39	36.9	

*.05 level, F = 4.10; .01 level, F = 7.35

TABLE XXIII

ANALYSIS OF VARIANCE OF DATA
FROM THE NEGATIVE TRANSFER EXPERIMENT.
COMPARISON OF 20 HIGH- AND 20 LOW-ANXIETY SUBJECTS
FOR NUMBER OF CORRECT RESPONSES
TO THE CHANGED FORMS OF SECOND-DEGREE SIMILARITY

Source of Variation	DF	Mean Square	F*
Between	1	250.0	6.91
Within	38	36.2	
Total	39	41.6	

*.05 level, F = 4.10; .01 level, F = 7.35