THE CORRELATES OF MANIFEST ANXIETY IN A MODIFIED STROOP-TYPE COLOR-WORD INTERFERENCE TEST AND A LETTER TRANSFORMATION TASK

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CHAPTER I

INTRODUCTION AND REVIEW OF THE LITERATURE

In the course of the last two decades an extensive body of research in psychology has been devoted to an examination of certain theoretical notions regarding the relationship between general drive (D) and performance in a number of learning situations. More specifically, much of this work has been concerned with an experimental analysis of certain basic assumptions derived from the behavior theory of Clark L. Hull regarding the effect of variations in drive on performance in human learning.

Drive Theory

According to Hull (1943) all habits (H) elicited by a given stimulus combine multiplicatively with existing drive (D) to form a hypothetical excitatory potential (E) which represents response strength, or the probability that a response learned to a specific stimulus will occur. Schematically, this is represented by the formula: $E = f(H \times D)$. Within Hull's system (H) represents the hypothetical learning variable which is considered to be a function of such things as the number, amount, and type of past reinforcements, etc. The construct (D) represents the total effective drive strength operating in the organism at a given time, including that stemming from both learned and unlearned sources (Taylor, 1951).

Since E is a primary determinant of response strength, variations in drive (D) would be expected to have a direct effect on response strength. Therefore, in situations where a single dominant response is evoked, i.e., where there is little or no competition from other responses, the greater the value of D the higher the value of E, and therefore the greater the response strength, or the probability that the response will occur. Under these circumstances, higher level of drive would be expected to lead to superior performance (Taylor, 1956).

However, in situations where a number of competing responses may be elicited by the same stimulus, predictions concerning performance under different levels of drive are considerably less clear cut, and require consideration of the number and relative strength of various correct and incorrect response tendencies within an individual's response hierarchy. Where there is a stronger probability of the correct response being subordinate to various incorrect responses within the individual's response hierarchy, increases in drive would be expected to lead to decrements in performance. This circumstance results from the fact that higher levels of drive would contribute equally to both correct and incorrect response tendencies, so that the larger differences in excitatory potential would favor the incorrect responses. On the other hand, when the correct response tendency is highest in the response hierarchy and relatively strong when compared to the incorrect responses, increases in the level of drive should produce an E value which is relatively greater for the correct response, leading to predictions of superior performance under higher levels of drive (Taylor, 1956).

However, even in situations where the correct response is slightly stronger than the incorrect responses, it is theoretically possible that increases in drive could still increase the frequency of incorrect responses. Resolution of this apparent contradiction requires the introduction of additional Hullian concepts: oscillatory inhibition (O) and threshold (L) (Taylor, 1956). O represents within-individual variability in behavior which results from uncontrolled variations, from moment to moment, within both the individual and his environment. The value of O is considered to fluctuate from moment to moment roughly in the form of a normal probability function (Taylor, 1956). Schematically, O, being considered an inhibitory function, is subtracted from E to create momentary excitatory potential $\bar{\bar{E}}$ (Taylor, 1956). (L) or threshold represents the minimum value of E required to produce a response. (L) is presumably the same for all similar habits activated by a given stimulus (Taylor, 1956). Schematically, all this is represented by the formula: $R = f(E - O - L)$ (Taylor, 1956).

With consideration of the above constructs, it follows, therefore, that the relative strengths of various correct and incorrect responses are not the only things which must be considered. Although an increase in drive would normally be expected to increase the excitatory potential of the correct response more than that of various incorrect responses, it would also be expected to increase the probability that these incorrect responses may achieve values above the threshold (L). Thus, it is theoretically possible that a momentary downward oscillation (O) of the correct response (dominant), combined with a momentary upward oscillation of the incorrect response (weak) may create a momentary excitatory potential that is greater for the weaker incorrect response. Therefore, the weaker incorrect response could occur. Obviously, there is no possibility that this could occur as long as the weaker incorrect responses remain subthreshold (Farber, 1955).

Review of the Literature

As was noted in the previous section, in stimulus situations where a single dominant habit is evoked higher levels of drive are expected to facilitate performance. Such a situation can be said to exist in the case of classical conditioning where only a single response tendency is being acquired. According to Hullian theory (following Taylor, hereafter referred to as drive theory), therefore, subjects (Ss) operating under higher levels of drive would be expected to acquire the conditioned response more rapidly than low drive Ss. Welch, and Kubis, in an early study (1948), provided some empirical confirmation for these theoretical predictions. Since chronic, free floating anxiety was considered to provide a significant increment to general drive, these investigators studied the rate of conditioning of the GSR in normal and pathologically anxious Ss (hospitalized patients). As expected they found that conditioning of the GSR was significantly more rapid in the anxious (high drive) group (Taylor, 1956).

Another early study (Malmo and Amsel, 1948) compared psychiatric patients with severe anxiety symptoms (high drive) with normal Ss on a more complex learning task where considerable response competition was anticipated. In this task the Ss were required to learn one list of nonsense syllables, and immediately following this, to learn a second list differing somewhat from the first. Since the second list presumably introducted incompatible and competing response tendencies, drive theory would predict superior performance for the normal, low anxious

Ss. As predicted, the results showed that the anxious group made significantly more interference errors and was considerable slower than the normal group in learning the second list (Taylor, 1956).

The Taylor Manifest Anxiety Scale

Historically, the bulk of the research which has attempted to examine drive theory predictions regarding the effect of variations in drive on performance in human learning was stimulated by the creation, in the psychological laboratories of the University of Iowa, of the Manifest Anxiety Scale (MAS) (Taylor, 1953). This true-false questionnaire was originally constructed for use as a measure of drive in a series of eyelid conditioning studies (Taylor, 1951). In its final form it consisted of 50 items, chosen from the Minnesota Multiphasic Personality Inventory, which were considered indicative of chronic anxiety reactions by a group of clinical psychologists. Interspaced with the above items were a number of additional buffer items considered by the judges to be non-indicative of anxiety. Construction of this instrument as a measure of drive level was based on two assumptions: first, that an individual's level of drive is related to his level of internal anxiety or emotionality, and second, that the intensity of this drive could be assessed by a paper and pencil test (Taylor, 1953).

MAS and Simple Learning Tasks

Since its inception in 1951, the MAS has generated a large volume of empirical research which has examined the relationship of drive level to performance in a wide range of learning situations. Perhaps the most favorable results in terms of drive theory formulations have come from studies which have employed the MAS as a measure of drive in classical conditioning. As was noted previously, classical conditioning is generally considered a non-competitional situation involving the acquisition of a single response tendency. Therefore, if the MAS is an efficient measure of drive, then drive theory would predict that superior performance should be associated with higher levels of MAS. Generally, this has indeed been the case. A large number of studies (Spence and Farber, 1953; Spence, Farber, and Taylor, 1951; Spence and Taylor, 1951; Spence and Taylor, 1953; Taylor, 1951) using some form of classical conditioning procedure have supported this prediction.

Reynolds, Blau, and Hurlbut (1961) gave a series of simple addition problems and a letter cancelation task to high and low scorers on the MAS. Their results indicated that superior performance on these tasks was associated with higher levels of MAS. This was consistent with theoretical expectations since the above tasks, like classical conditioning, were thought to involve single non-competitional response tendencies.

MAS and Complex Learning Tasks

Although the results from studies involving simple learning tasks have generally been favorable to drive theory predictions, the evidence from experiments utilizing more complex tasks is considerably less straight-forward. As was previously stated, more complex learning tasks are usually thought to involve incompatible and competing response tendencies. Therefore, since higher levels of drive are believed to contribute equally to both correct and incorrect response tendencies, in cases where the correct response is initially weaker than various competing responses, elevations in drive would be expected to lead to decrements in performance for high anxious Ss in comparison to low anxious Ss. An early attempt to evaluate experimentally these predictions was made by Taylor and Spence (1952). In order to demonstrate that the performance of anxious Ss is a function of the degree of interference within a task, these experimenters administered a serial verbal maze to two groups of Ss composed of high and low scorers, respectively, on the MAS. On the assumption that errors on this test are largely a function of interfering response tendencies due to remote associations, it was anticipated that high MAS Ss would require more trials to reach a criterion of learning and make more errors in the process. The results supported both predictions, the anxious Ss making significantly more errors and requiring more trials to criterion than the low anxious Ss (Taylor, 1956).

Subsequent investigations by Farber and Spence (1953), and Matarazzo, Ulett, and Saslow (1955), using a stylus maze task, provided results consistent with drive theory predictions, and in support of the results of Taylor and Spence (1952).

However, elsewhere in the literature studies have been reported which do not support drive theory predictions. Axelrod, Cowen, and Heilizer (1956), were unable to replicate the results of the stylus maze study of Spence and Farber (1953), and Hughes, Sprague, and Bendig (1954) using several serial verbal mazes like those of Taylor and Spence, found no significant differences between levels of MAS.

The status of drive theory formulations in regard to the performance of high and low anxious Ss on stylus and verbal mazes thus remains unclear. In general, the maze studies have attempted to demonstrate interaction between level of MAS (drive) and level of response interference by observing performance at various choice points within the maze, the anxiety-interference interaction being considered a function of the increasing difficulty or complexity at various choice points within the maze (Taylor, 1956). A number of other investigations, on the other hand, have attempted to control and experimentally manipulate interference by a somewhat different procedure. These experimenters, using several verbal learning tasks, have attempted to control the level of interference by using several separate tasks, each providing a different interference value (Taylor, 1956). Montague (1953), for example, created three different lists of serial nonsense syllables, each differing in terms of inter-list similarity and association value and therefore presumably differing in interference value. The three lists were administered to two groups of Ss composed of high and low scorers, respectively, on the MAS. As expected, the results showed a significant interaction between anxiety and lists, the high anxious Ss demonstrating superior performance on the list for which similarity was low and association value high, and the low anxious Ss performing relatively better on the list with high similarity and low association value (Taylor, 1956).

In the search for a task that allows more precise control over the number and strength of various response tendencies evoked by a given stimulus situation, many investigators have turned to various paired associates techniques. In a study conducted by Spence (1953), an attempt was made to introduce a high degree of response competition by using pairs of adjectives with a high degree of formal similarity. The results of this study, in line with drive theory predictions, showed that the performance of high MAS Ss was significantly poorer than that of low MAS Ss. A later study by Taylor and Chapman (1955), used paired associates which, in contrast to the ones used by Spence, emphasized low formal similarity between members of each pair. Again as predicted, the results this time favored high anxious Ss (Taylor, 1956).

The results of several subsequent paired associates studies (Lee, 1961; Spence, Farber, and McFann, 1956; Spence, Taylor, and Ketchel, 1956) have provided additional evidence favoring drive theory predictions (Hays, 1966).

However, as was the case with the maze performance literature, some negative findings have been reported. Besch (1959), using a paired associates task obtained results which were contrary to drive theory predictions, and at odds with the results of Spence, Farber, and McFann (1956). Daily (1953), using a verbal conditioning task found no significant differences between high and low scorers on the MAS (Hays, 1966).

Summary and Conclusions

As the preceeding brief review of the literature has revealed, the results of studies employing the MAS as a measure of drive in classical conditioning studies and simple learning situations have generally confirmed drive theory predictions. Drive theory, however, has faired less well in the literature on the effects of drive on performance in more complex learning situations. The contradictory results obtained by researchers using MAS as a measure of drive in complex learning situations have been interpreted by some (Besch,

1959) to indicate that considerable reformulation of drive theory in this area may be necessary. However, it seems questionable whether these studies as a whole have really constituted a crucial test of drive theory assumptions. For instance, the majority of these investigations have employed tasks which do not always allow a clear understanding of the nature of the competing responses presumed to be operating, and few have provided any meaningful quantitative descriptions of the relative habit strengths of responses elicited by the stimulus materials. In addition, the widespread use of tasks such as paired associates and word mazes may have resulted in the introduction of such uncontrolled sources of variation as the level of vocabulary knowledge and the denotative and conotative meaning of words (Sassenrath, Knigh, and Athey, 1964).

In summary, although the full efficiency of drive theory in providing unequvocal predictions concerning the interaction between drive and task complexity has perhaps not been fully demonstrated at this point, final pronouncements concerning the adequacy of drive theory in this context should perhaps await further research. Additional empirical research employing a wider range of behavior tasks which allow a clearer understanding of, and a more rigorous control over, the number and relative strengths of various response tendencies evoked by task related stimuli would be beneficial at this juncture.

The Stroop Color-word Test

Curiously absent from the repertoire of tasks used to test drive theory notions concerning the effects of variations in drive on performance in complex learning tasks is the classic response interference task, the Stroop Color-Word Test (Stroop, 1935).

During the last 32 years the Stroop test and its many variations have been used in some 70 studies involving a wide diversity of fields ranging from perception to psychopharmacology. Significant relationships have been found between Stroop factors and a large number of different psychological variables in these various subject areas (Jensen and Rohwer, 1966).

Before proceeding to an examination of the original Stroop experiments, a general description of the Stroop apparatus follows: The original Stroop test (Stroop, 1935) consisted of three cards; a color card, a word card, and a color-word card. The color card consisted of a 10 x 10 matrix of evenly spaced columns and rows of colored squares on a white background. Five colors were used; red, blue, green, brown, and purple. Each of the five colors occurred twice in each column and each row, and no two colors were used next to each other in either the columns or rows. The word card also consisted of a 10 x 10 matrix with the names of the colors on the color card spelled out in black ink on a white background. The same restrictions as to serial sequence which were used on the color card were also used on the word card. On the color-word, or interference card, the same five words were printed on a white background, but the color of ink used to print the words differed. On this card no word was printed in the color it named, but each word was printed an equal number of times in the other four colors. Thus, each word represented the name of one color printed in the ink of another color (Jensen and Rowher, 1966; Stroop, 1935).

The Stroop Color-Word Test was originally constructed by J.

Ridley Stroop for use in investigating interference in serial verbal reactions (Stroop, 1935). In the first phase of his initial experiment, Stroop (1935) required Ss to read, as quickly as possible, the names of colors printed in the ink of a different color on the color-word card. In the second phase, the Ss were required to read, as quickly as possible, the name of colors printed in black on the work card. No significant differences in reading time between the two cards were found.

In a subsequent experiment, Ss were first asked to name, as quickly as possible, the colors presented on the color card (squares). Following this, the Ss read the color of ink of words which name other colors on the color-word card. The results revealed a highly significant difference in mean color reading time between the two tasks, with the Ss requiring nearly twice as long to complete the color-word card (Stroop, 1935). This result, that is the inability of Ss to read the colors on the color-word card as rapidly as on the color card, is what is usually referred to as the Stroop phenomenon.

There is little question regarding the universiality of the Stroop phenomenon. Jensen and Rohwer in their recent review of the Stroop literature (1966) concluded that virtually all literate people are subject to it. In an experiment conducted by Jensen (1965), not one of his 400 Ss were able to name the colors on the color-word card as rapidly as on the color card.

There has also been little disagreement concerning the nature of the performance decrement on the color-word card. Virtually all experimenters since Stroop (1935) have interpreted the interference phenomenon as resulting from response competition between habits of unequal strength. The performance decrement is considered to be due to the necessity of inhibiting the stronger habit, word-reading in favor of the weaker habit, color naming, (Jensen and Rohwer, 1966).

Drive Theory and the Stroop Color-Word Test

Since inferior performance on the Stroop color-word card is attributed to competition between responses evoked by habits of unequal strength, according to drive theory formulations performance on this card should also be sensitive to variations in drive level. Since drive theory considers response strength to be a multiplicative function of drive and habit strength (i.e., H x D) or, in this case D $(H_w - H_c)$, as D increases, absolute differences between the habit strengths for the competing responses should also increase $(DH_w - DH_c)$, the larger difference favoring the incorrect response (H_w) (Jensen and Rowher, 1966). Therefore, greater performance decrements on the color-word card would be expected as an increasing function of drive.

Although no studies have been reported which test this prediction by means of the MAS, one experiment did investigate performance on the Stroop under different levels of experimentally induced drive. Agnew and Agnew (1963) used the threat of electric shock, together with informing the Ss that their intelligence was being tested, to produce high drive. Lower levels of drive were induced by instructions designed to be non-threatening and to put the Ss at ease. The two drive conditions were administered to two groups of Ss in a counterbalanced order. That is, one group performed first under the high drive condition and then under the low drive condition, while the other group performed under conditions of low drive first and subsequently under conditions of high drive. A third group received the low drive treatment twice (Jensen and Rohwer, 1966). The three groups of Ss received the Stroop and the Porteus maze test twice, the two dependent measures also being presented in a counterbalanced order.

Using the Stroop interference score CW - C, analysis of variance revealed no significant difference between the two drive groups on either the first or second administration, a result clearly not in accord with drive theory predictions. In fact, the experimenters, using a different Stroop score, obtained results in complete contradiction to drive theory expectations. Analysis of variance of a Stroop derived score consisting of the arithmetic sum of response times for the color card and the color-word card (i.e., C + CW) revealed a significant improvement in performance under high drive conditions. However, since C + CW is an amalgam of all three Stroop factors, this result is perhaps not too illuminating in terms of drive theory (Jensen and Rohwer, 1966). Clearly, as Jensen and Rohwer point out in their comprehensive review of the Stroop literature: "The most satisfactory method for studying the effects of drive on Stroop performance would be to assess the effects of drive on each of the Stroop factors separately" (Jensen and Rohwer, 1966, p. 83). This suggestion formed, in part, the basis for the present study.

CHAPTER II

THE PROBLEM

The conflicting results reported in the previous chapter regarding the relationship between MAS and performance in complex learning situations suggest that additional empirical research employing a wider range of behaviorial tasks is justified. Clearly, there is a need for tasks which permit more precise control over the level of task complexity, and preferably allow quantitative statements of that complexity defined independently of such vague concepts as task difficulty (Kamin and Fedorchak, 1957). It would also seem advantageous if the number of competing responses could be minimized and their nature readily ascertained.

In accordance with the above criteria, the present study utilized a form of the Stroop Color-Word Test modified for group administration. The selection of a Stroop-type task for use in the present investigation was based on the following rationale: (1) The Stroop Test allows the number of competing responses to be held to a minimum, i.e., two. (2) The nature of the competing responses operating in the situation is well understood. (3) The Stroop Test provides independent quantitative statements of the relative habit strengths of these competing responses (i.e., performance on the color and word cards). (4) The nature of the color-word interference card used in the Stroop Test allows statements of task complexity to be made independently of task difficulty.[1]

Beyond purely empirical justifications, the purpose of this study was to examine experimentally several drive theory predictions regarding the relationship between drive (as measured by the MAS), and performance on the three basic Stroop factors, i.e., color, word, and color-word measures. In addition, by an attempt to vary the degree of color-word congruity on each of three different color-word interference lists, it was hoped to control the complexity of the task in order to ascertain the interaction, if any, between MAS and task complexity (response competition).

In an attempt to gain additional empirical data on the correlates of MAS in complex learning situations, a second task was also utilized in this investigation. This task consisted of a letter transformation procedure which required serial alphabetic transformations at rule specified distances from stimulus letters (Weber, Cross, and Carlton, 1968). Within this task, Ss were presented lists of random letters to which they responded according to the transformation rule then in force. Three transformations were used; 0, +2, -2, meaning that the Ss were required to write the same letter, the letter that occurred two letters forward, and the letter that occurred two letters backward, respective-

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[1]Since task difficulty is, itself, often defined in terms of performance decrements relative to other tasks, definitions of task complexity in terms of task difficulty may lead to somewhat circular reasoning in situations where task complexity, for one reason or another, is expected to lead to poorer performance. Merely postulating the existence of certain hypothetical competing responses seems an inadequate means of breaking the circularity unless the nature of these competing responses can be clearly specified.

ly, in serial alphabetic sequence from the stimulus letter. By the use of the above sequence of transformation rules, it was hoped to produce competing responses in such a way that drive theory predictions regarding an interaction between MAS and response competition could be evaluated.

Predictions

The predictions made in this study are derived from theoretical formulations of Hullian Drive Theory (Hull, 1943; Taylor, 1956).

The following predictions for performance on the Stroop Test were made:

1. Level of performance on the word (W) list, and the color (C) list will be an increasing monotonic function of level of MAS.

2. There should be an interaction between level of MAS and level of task complexity, with performance on the color-word (C-W) lists .0 and .5 being a decreasing monotonic function of MAS, and level of performance on color-word (C-W) list 1.0 being an increasing monotonic function of MAS.

The hypothesis for the letter transformation task was as follows:

3. There should be an interaction between MAS and sequence of transformation tasks in the order: 0, +2, -2, with level of performance on the 0 transformation being an increasing monotonic function of MAS, and performance on transformations +2 and -2 being a decreasing monotonic function of MAS.

The rationale upon which these predictions were based will now be briefly considered. The first hypothesis is based upon drive theory predictions concerning performance on simple, noncompetitional learning tasks. Since higher levels of drive are presumed to facilitate performance in situations where only a single dominant response is evoked, and responses elicited by the color and word lists are thought to be relatively free from competing responses, higher levels of MAS should lead to performance increments on these tasks.

The second hypothesis stems from drive theory predictions that an interaction should occur between MAS and the degree of response competition. Since response competition in this study was defined in terms of the number of color-word incongruities on each of the color-word interference lists, it might be anticipated that as the level of interference goes from complete congruity (no interference) on the 1.0 list to half congruity (medium interference) on the .5 list, to complete incongruity (high interference) on the .0 list, increasing levels of MAS (drive) should first facilitate and then inhibit performance.

The third prediction, concerning performance on the letter transformation task, is again based on the notion of an interaction between drive (MAS) and response competition. Since the transformation rules were presented to all Ss in the order, 0, +2, -2, each transformation was presumed to build up, through practice, response tendencies incompatible with those required by the next transformation. For example, practice on the 0 transformation, requiring only that the Ss write the same letter as the stimulus letter, would be expected to reinforce an already strong existing habit for letter copying. Subsequently, on the next transformation (+2), one with presumably weaker existing habit strength, this original response tendency would be expected to interfere with the now correct response of writing the letter that occurs two forward in the alphabet. Finally, on the third transformation (-2), which is considered to have the lowest existing habit strength of the three, competition from response tendencies acquired through practice on both of the previous transformations would be expected to compete with the correct response of writing the letter that occurs two back in alphabetic order from the stimulus letter. Therefore, increasing levels of MAS should, as on the three C-W lists, first facilitate and then increasingly inhibit performance as the sequence of transformations proceeds.

CHAPTER III

METHOD

Subjects

The Taylor Manifest Anxiety Scale (MAS) (Taylor, 1953) was initially given, under the title of Biographical and Personality Inventory, to a sample of 436 male Ss enrolled in introductory psychology classes at Oklahoma State University. The "Inventory" consisted of 50 MAS items, combined with 38 items drawn from the MMPI L and K scales which were used as buffer items. The total number of items was 88 (Sjoberg, 1966).

Following the administration of this instrument, Ss were selected according to the following criteria: High Anxiety (H.A.), those individuals whose scores constituted the top 60 scores in the distribution; Medium Anxiety (M.A.), those individuals whose scores constituted the middle 60 scores in the distribution; Low Anxious (L.A.), those individuals whose scores constituted the bottom 60 scores in the distribution. The three MAS levels were characterized by the following parameters: H.A., scores of 25 or greater; M.A., scores in the interval 13-16; L.A., scores of 8 or less. Because a large number of potential Ss either failed to show up, or for some other reason were excused from the experiment, the number of Ss actually used in the experiment from each of the above MAS levels was as follows: H.A., N = 36; M.A., N = 34; L.A., N = 36.

Materials and Apparatus

The Color-Word Test

The color-word interference test constructed for use in this investigation consisted of a version of the Stroop Color-Word Test (Stroop, 1935) modified to allow for a group administration. In its final form it consisted of six 8 x 10 overlay plastic transparencies suitable for use with an overhead projector. The first transparency consisted of a color blindness screening test and was not part of the actual color-word test materials. The remaining five transparencies consisted of a color list, a word list, and three color-word interference lists. Four colors were used: red, blue, green, and brown.

The color (C) list was composed of 32 units of X's, each unit of X's being composed of four X's. The 32 units were laid out in the form of a 4 x 8 matrix of evenly spaced columns and rows. Each unit of X's was tinted in one of the above colors. The colors were arranged in a random order within the list with the following restrictions: (a) every color occurred an equal number of times (8) somewhere in the list; (b) every color occurred at least once in every column; (c) no color succeeded itself anywhere within the list, i.e., no doublets or triplets of the same color.

The word (W) list consisted of a 4 x 8 matrix of evenly spaced columns and rows of words spelling out the name of the same four colors used on the (C) list. All words were printed in black ink. The words were arranged in a random sequence within the list with the following restrictions: (a) every name of a color occurred an equal number of times (8) within the list; (b) every name of a color occurred at least once in every column; (c) no name of a color succeeded itself anywhere within the list, i.e., no doublets or triplets of the same color name.

The color-word (CW) interference lists consisted of three forms, each composed of a 4 x 8 matrix of evenly spaced columns and rows of color names printed in colored ink. The three forms differed in the number of incongruous combinations of names of colors and colors of ink used to print the names.

On CW list .0 (.000 congruity), no word was printed in the color it named. The names and colors were arranged in a random order within the list with the following restrictions: (a) each name and each color occurred an equal number of times (8) within the list; (b) each name and each color occurred at least once in each column; (c) no name and no color succeeded itself anywhere within the list, i.e., no doublets or triplets of colors or names.

On CW list .5 (.500 congruity), half the words were printed in ink the same color as the color they named, and half were printed in a color of ink incongruous with the color they named. The names, colors, congruities, and incongruities were arranged in random sequence within the list with the following restrictions: (a) each name, each color, and congruous and incongruous combinations of each name and color occurred an equal number of times within the list; (b) each name and each color occurred an equal number of times in each column; (c) no name and no color succeeded itself anywhere within the list, i.e., no doublets or triplets of names or colors.

On CW list 1.0 (1.000 congruity), every word was printed in the color it named. The names (colors) were arranged in random order within the list with the following restrictions: (a) each name (color) occurred an equal number of times (8) within the list; (b) each name (color) occurred an equal number of times in each column; (c) no name (color) succeeded itself anywhere within the list, i.e., no doublets or triplets of names (colors).

The color blindness screening device consisted of four units of X's like those used on the (c) list. Each unit was tinted one of the colors used in the above color-word test.

The five color-word lists were projected on a 5' x 5' Radient Educator mat white tripod screen by means of an American Optical Opollo 6 Quartz-Iodine 17,000 CP Overhead Projector, model no. 3651, with a 600 watt fjj lamp.

Response forms for the color-word test consisted of booklets of seven mimeographed pages. On the first page four separate blanks across the top of the page were used for recording responses to the color blindness screening test. Below these blanks, and on each of the following six pages were 32 blanks laid out in a 4 x 8 matrix corresponding to the stimuli on the color-word lists. These were used by the Ss to record their responses.

The Letter Transformation Test

Materials for the letter transformation task consisted of a three page mimeographed booklet (see Appendix A). On each page of this booklet the 26 letters of the English alphabet, printed in elite type, were presented in random sequence in three separate columns. All nine columns within the booklet were independently randomized. To the side of each letter was a blank provided for the S's response.

Procedure

In an attempt to provide a more optimal environment for visual acuity on the color-word interference test, Ss were tested in groups whose mean number was approximately six. Since some Ss failed to show up at the appropriate time, several Ss were tested individually. An attempt was made to include an equal number of Ss from each level of MAS in each experimental session. However, as many Ss did fail to arrive at their originally scheduled time period, several testing sessions included a disproportionate number of Ss from one or the other of the MAS groups.

All Ss were told that they had been selected to participate in an experiment involving clerical speed and accuracy under different stimulus conditions. There was no apparent indication that any of the Ss made the connection between this experiment and the MAS administered at least six weeks previously.

As figure 1 indicates, the present investigation can be considered as two separate studies. For the color-word test, 12 Ss from each of the MAS levels were assigned randomly to one of the three CW interference groups (i.e., CW list .0, .5, or 1.0). All Ss received the (C) and (W) lists. Order of presentation of the (C), (W), and CW lists was counterbalanced for each of the three CW lists (see figure 1). All Ss received two trials on each of his lists.

Following the completion of the color-word test, all Ss performed the letter transformation test in the order, 0, +2, -2 (figure 1). However, since transformations served as a repeated measures variable, the number of Ss in each of the three MAS groups was reduced, for the sake of computational convenience, to a total of 25. This was accom-

Color-Word Interference Test

LEVELS OF MAS	List .0	List .5	List 1.0
High	C, W, CW, N = 12 CW, W, C	C, W, CW, N = 12 CW, W, C	C, W, CW, N = 12 CW, W, C
Medium	C, W, CW, N = 12 CW, W, C	C, W, CW, N = 10 CW, W, C	C, W, CW, N = 12 CW, W, C
Low	C, W, CW N = 12 CW, W, C	C, W, CW N = 12 CW, W, C	C, W, CW N = 12 CW, W, C

Letter Transformation Test

Transformations*

LEVELS OF MAS	0	+2	-2
High	N = 36	N = 36	N = 36
Medium	N = 34	N = 34	N = 34
Low	N = 36	N = 36	N = 36

Figure 1. Experimental Design of the Study

*The three transformation rules served as repeated measures in this design.

plished by randomly removing from the distribution the data for 11 Ss in the low anxious group, 11 Ss in the high anxious group, and 9 Ss in the medium anxious group, leaving a total of 25 in each group.

Upon entering the experimental room, each S was handed a response booklet for the color-word test. The following instructions were then read to the Ss:

> This is an experiment concerned with clerical speed and accuracy under different stimulus conditions. For this experiment you will need only a pen or pencil. Please write your name on the answer booklet. For the remainder of the experiment do not converse with anyone except the experimenter. If you have any questions, please ask me.

The room was then darkened by closing venetian blinds on all the windows. Following this, the overhead projector was turned on and the first transparency, the color blindness screening test, was projected on the screen. The instructions continued:

> Now if you will look at the four groups of X's on the screen you will notice that each is of a different color. Now if you will glance at the first page of your answer booklet you will notice four blanks across the top of the page (demonstrated). The first thing I would like you to do is write down the name of the color of each of the groups of X's on the screen, in the order from left to right, in the appropriate blank on the first page of your answer sheet (demonstrated).

Generally, at this point if any S was aware that he was color-blind, he made this fact known to the experimenter, and he was excused from the remainder of the experiment. Several Ss were thus eliminated. After allowing approximately one minute for the Ss to complete their responses, the color blindness slide was removed from the projector.

Since preliminary validation research with the color-word test used in this investigation had revealed a highly significant practice effect on the first list presented (the color list), and inspection of S's responses on this list gave indications that a considerable part of this variance might be due to unfamiliarity with the task, it had been decided to administer a color list as an initial warm-up exercise. The nature of the (c) list transparency allowed, by presenting the slide right side up, upside down, backwards, and forwards, four separate sequences of colors to be administered. Therefore, during the three administrations of the color list an attempt was made to present a sequence on the warm-up trial different from the two subsequent experimental trials. The instructions continued:

> Now I'm going to show you more groups of X's of various colors much like the ones you just saw. However, this time there will be whole rows and columns of them. Your instructions on this trial are to write down, in the corresponding blanks on your answer sheet below the spaces you just filled in, the <u>first</u> <u>two</u> <u>letters</u> of the name of each color as rapidly as possible. In making your responses, please work down each column, moving left to right (demonstrated). This test has a time limit so complete each response as quickly as possible. Remember, however, that your answers must be legible to be correct. Please wait for me to tell you to start before you begin, and please stop instantly when I tell you to stop, even if you are only halfway through a response. This is very important because of the timed nature of this test.

The experimenter then demonstrated on the blackboard the correct procedure for making responses in this task. The experimenter then stated:

> If there are any questions about what you are to do on this task, please ask them now.

The experimenter then inserted the color (c) list in the projector. After the slide was positioned to his satisfaction, he told the <u>S</u>s to begin. At the same instant, an experimental assistant situated across the room activated a standard electric timer. Twenty seconds were allowed for this warm-up trial, and all subsequent experimental trials. After completion of this preliminary warm-up trial, and following all subsequent experimental trials, a one minute rest interval was allowed before beginning the next list. Following completion of the practice trial, the series of experimental trials commenced. The instructions were as follows:

> This time I am going to show you another list of colored X's similar to the ones you just responded to on the last trial. Your instructions this time are exactly the same as before, you are to write down the first two letters of each color as rapidly and as accurately as possible. Again, please be sure to stop and start on cue.

Following this, the experimenter reinserted the (C) list in such a way that the sequence of colors was different from that used on the practice trial. Following the completion of this trial, the experimenter removed the (C) list and presented the following instructions for the (W) list:

> Please turn to the next page in your answer booklet. This time I am going to show you a list of words, printed in black, but which name various colors. Your task this time is to write down the first two letters of each <u>word</u> as rapidly and as accurately as possible.

Following this, the experimenter demonstrated on the blackboard the required responses on this test. The <u>S</u>s were again reminded to start and stop on cue, and the (W) trial was run. After completion of the (W) list, the instructions for the CW interference lists were given:

> Please turn to the next page of your answer booklet. This time I am going to show you a list of words which are again the names of various colors. However, this time the words themselves are printed in colored ink, and the ink in which the words are printed may not correspond with the color the words name. Your instructions this time are to write down, as rapidly as possible, <u>the color of ink</u> in which the words are printed.

At this point, the experimenter again demonstrated on the blackboard, this time by the use of colored chalk, the correct procedure for responding to a sample of stimuli encountered on this test. The sample included both congruous and incongruous combinations. After the experimenter completed answering any questions, the Ss were again reminded to start and stop on cue and the CW trial was completed.

After completion of the CW list, the three lists were readministered in reverse order. The instructions were as follows:

> Please turn to the next page of your answer booklet. I am now going to show you that last list again. Your instructions are the same as before. You are to write down, as rapidly as possible, the first two letters of the color of ink in which each word is printed.

Following completion of the second trial on the CW list, the (W) list was readministered. The instructions stated:

> Please turn to the next page in your answer booklet. This time I am again going to show you the list of words printed in black. Your instructions are the same as before, you are to write down the first two letters of each word as rapidly and as accurately as possible.

After completion of the (W) list, the (C) list was presented a second time. The instructions were as follows:

> Please turn to the last page in your answer booklet. This time you will again be presented the list of colored X's. Your task, as before, is to write down the first two letters of the color of each group of X's as rapidly and as accurately as possible.

The color-word test now completed, the response booklets were collected and the response forms for the letter transformation task were distributed in their place. After allowing approximately two minutes for the Ss to enter their names on the letter transformation booklet, and to dissipate any residual tension from the last task, the second experiment was begun. The following instructions were presented:

> Look at the first page of your test booklet. On this page you will see that there are three columns of letters with blank spaces out to the side of each letter. Your task on this first page will be to write each letter in the blank out to its side.

The experimenter then demonstrated on the blackboard the appropriate response procedure. The instructions continued:

> As was the case in the previous experiment, there is a time limit on this test so work as rapidly and as accurately as possible. Again, your letters must be legible to be correct. Please work down each column moving from left to right (demonstrated). As before, please start and stop instantly on cue.

After answering any questions, the experimenter gave the signal to begin and, as before, the experimental assistant activated the electric timer. Thirty seconds were allowed for this, and all subsequent transformations, with a one minute rest interval following each trial.

After the 0 transformation trial was completed, the instructions continued:

> Please turn to the second page of your booklet. On this page your task will be to write the letter that occurs two letters forward, or up in alphabetical order from each letter in the columns, i.e., two letters away in alphabetical order.

Again, the experimenter demonstrated on the blackboard the desired manner of responding on this task. Following completion of the +2 transformation, the instructions for the final transformation rule were presented:

> This time your task is the reverse of the previous one, you are to go backward two letters in reverse alphabetical order from each letter in the column.

The correct procedure having been demonstrated, the final -2 transformation trial was completed.

CHAPTER IV

RESULTS

For the most part, the basic unit of measurement on both experimental tasks used in this investigation consisted of the number of responses completed during a specified time interval. Where appropriate, however, separate analyses were performed for the absolute number of responses actually completed, and the number of responses completed without error (correct responses) during the time interval.

Following Davids and Eriksen, (1955); Shultz and Calvin, (1955); and Taylor, (1953, 1955), an assumption of intellectual communality was made for the three MAS groups.

Color-Word Interference Test[2]

For the color and word lists, independent analyses were made of performance on each list as a function of MAS. With regard to the color list, analysis of variance (Table I) revealed a nonsignificant relationship between level of MAS and mean number of responses completed

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[2]Since the experimental design for the color-word interference test did not contain an equal number of Ss in every cell, for the purposes of statistical analysis it was necessary to estimate the data for two hypothetical Ss in cell 2,2 (M.A., List .5). Following Lindquist, (1953, p. 148), this was accomplished by computing the mean of the cell in question for each list score and each derived score for each separate trial. The appropriate estimated value was then entered in the cell total twice, and the analysis of variance was performed with two degrees of freedom being subtracted from both the between and within error term and four degrees of freedom from the total.

during the time interval, a result not in accord with predictions. On the other hand, a highly significant main effect was associated with trials. Reference to Figure 2 shows that performance differences on the first trial, while generally favoring higher levels of MAS, were very slight. On the second trial all groups demonstrated significantly improved performance, with the high anxious group maintaining and even increasing its superiority over low anxious Ss. However, the greatest increment in performance on the second trial was exhibited by the medium anxious group. On this trial the mean score of the medium anxious Ss actually exceeded that of the high anxious group.

TABLE I

AOV OF SCORES ON THE COLOR LIST AS A FUNCTION

OF MAS AND TRIALS

Source	df	SS	MS	F
Anxiety	2	17.2870	8.6435	.4406
Error (bet)	103	1907.8745	18.5231	
Trials	1	190.7824	190.7824	55.8890***
Tr. X Anx.	2	8.1204	4.0602	1.1894
Error (with)	103	351.5964	3.4136	
Between Ss	105	1925.1615		
Within Ss	106	550.4992		
Total	211	2475.6607		

***Significant beyond the .001 level

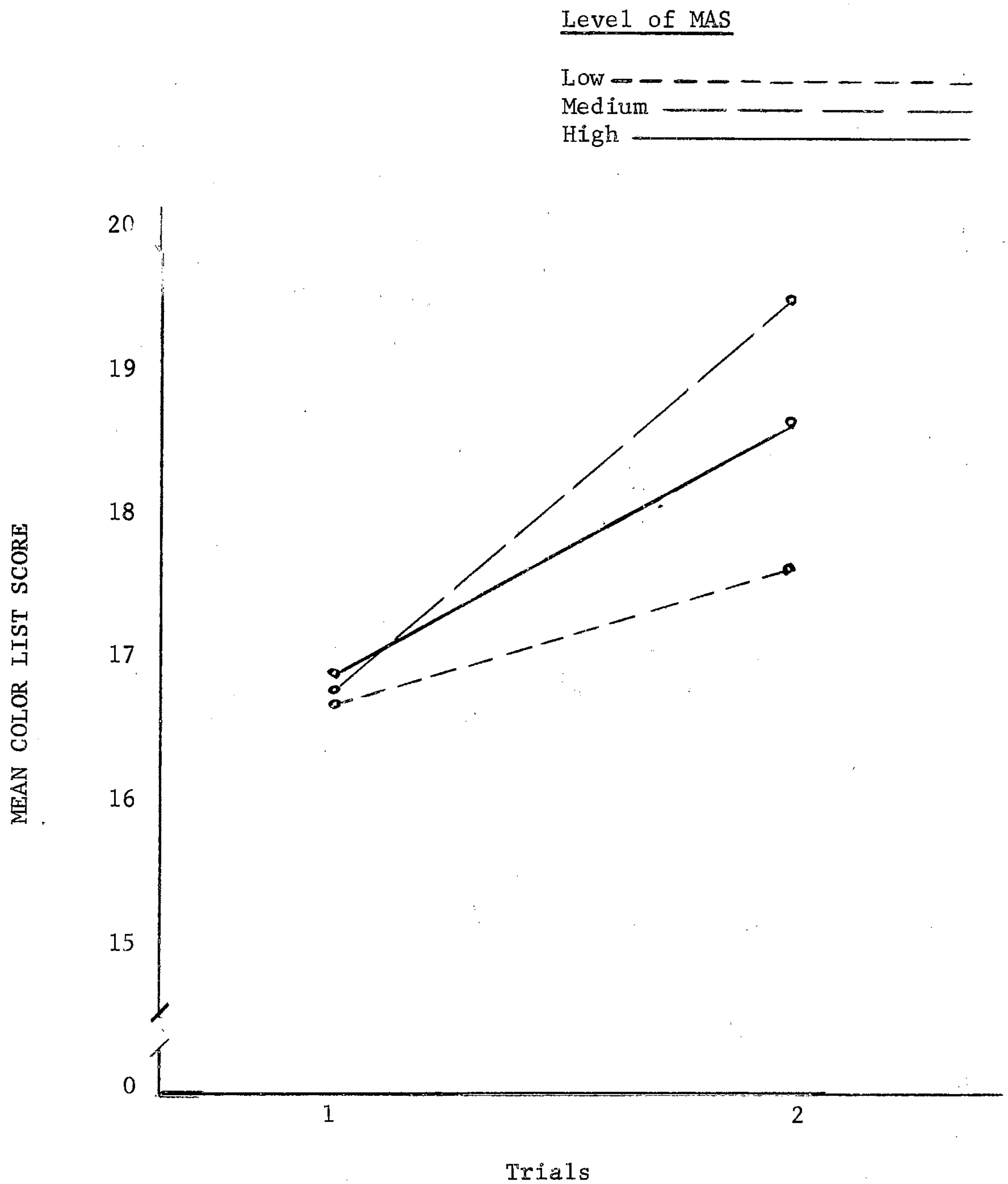

Figure 2. Mean Color List Performance of the Three MAS Groups

Analysis of variance of scores on the word list (Table II) also revealed insignificant differences between levels of MAS, and again a significant trials effect was observed. As Figure 8 illustrates, performance on both trials followed an overall pattern similar to that seen on the color list. On the first trial performance differences, although slight, again favored higher levels of MAS. On the subsequent trial, the high anxious group increased its superiority over the low anxious Ss, but its performance again fell short of that of the medium anxious group. Clearly, the results of the analyses of color and word list performance do not support the prediction of superior performance on these tasks as an increasing function of MAS.

For the color-word lists, separate analyses were performed for the absolute number of responses completed and the number of correct responses completed during the 20 second time interval.

Table III presents an analysis of variance of absolute scores on the color-word lists as a function of MAS, lists, and trials. Significant main effects were obtained for lists and trials. Contrary to predictions, however, both the main effect for anxiety and the anxiety-lists interaction failed to reach significance. This indicates that scores on the color-word lists were apparently independent of level of anxiety, a result clearly inconsistent with the hypothesis.

Figure 5 illustrates overall (across trials) performance of the three MAS groups on each list. On list .0 (.000 congruity), superior performance was associated with higher levels of MAS, a trend directly opposite that predicted. On list .5 (.500 congruity), overall performance differences, although slight, were in the direction of the hypothesis. On list 1.0 (1.000 congruity), high anxious Ss as predicted out-

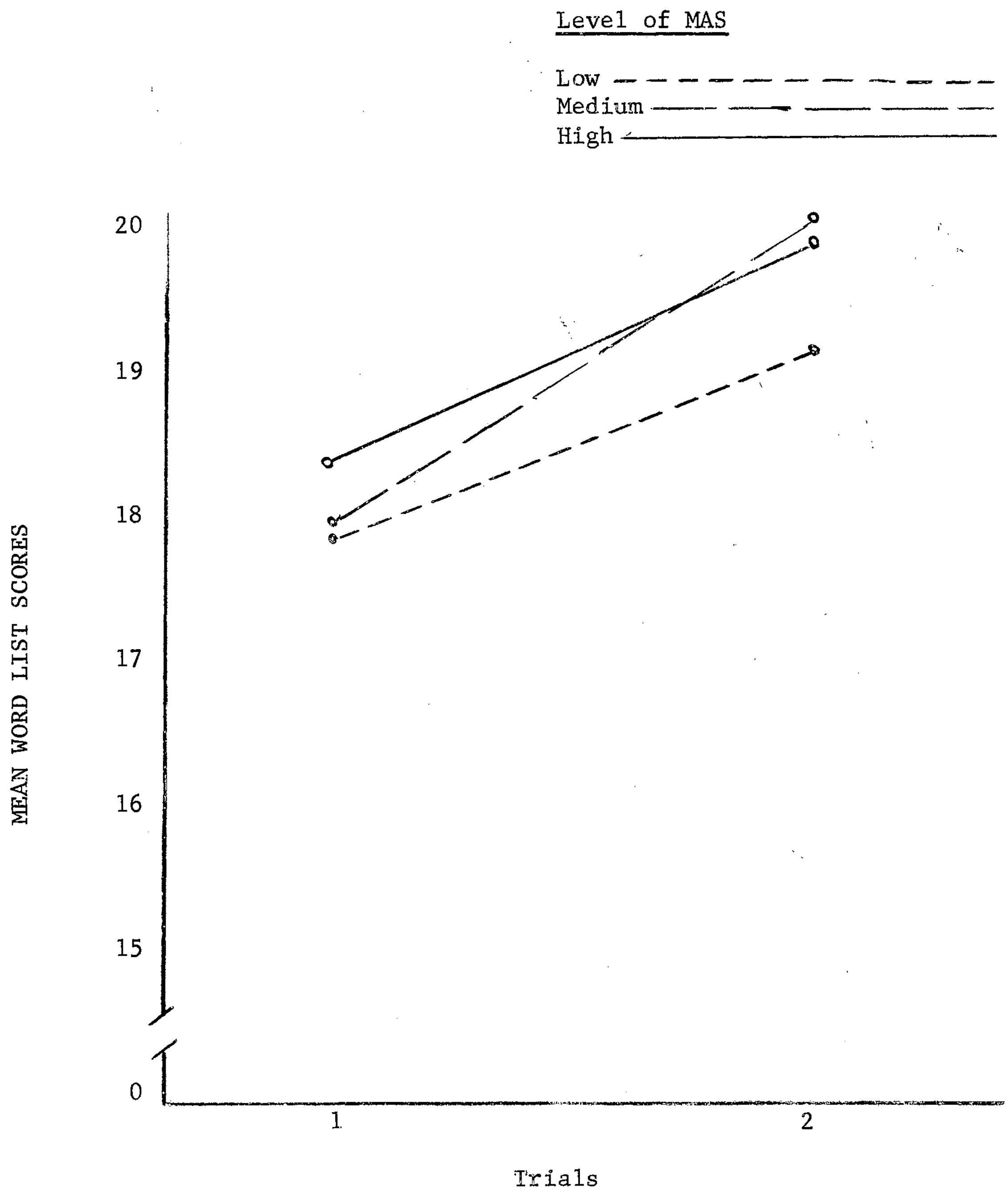

Figure 3. Mean Word List Performance of the Three MAS Groups

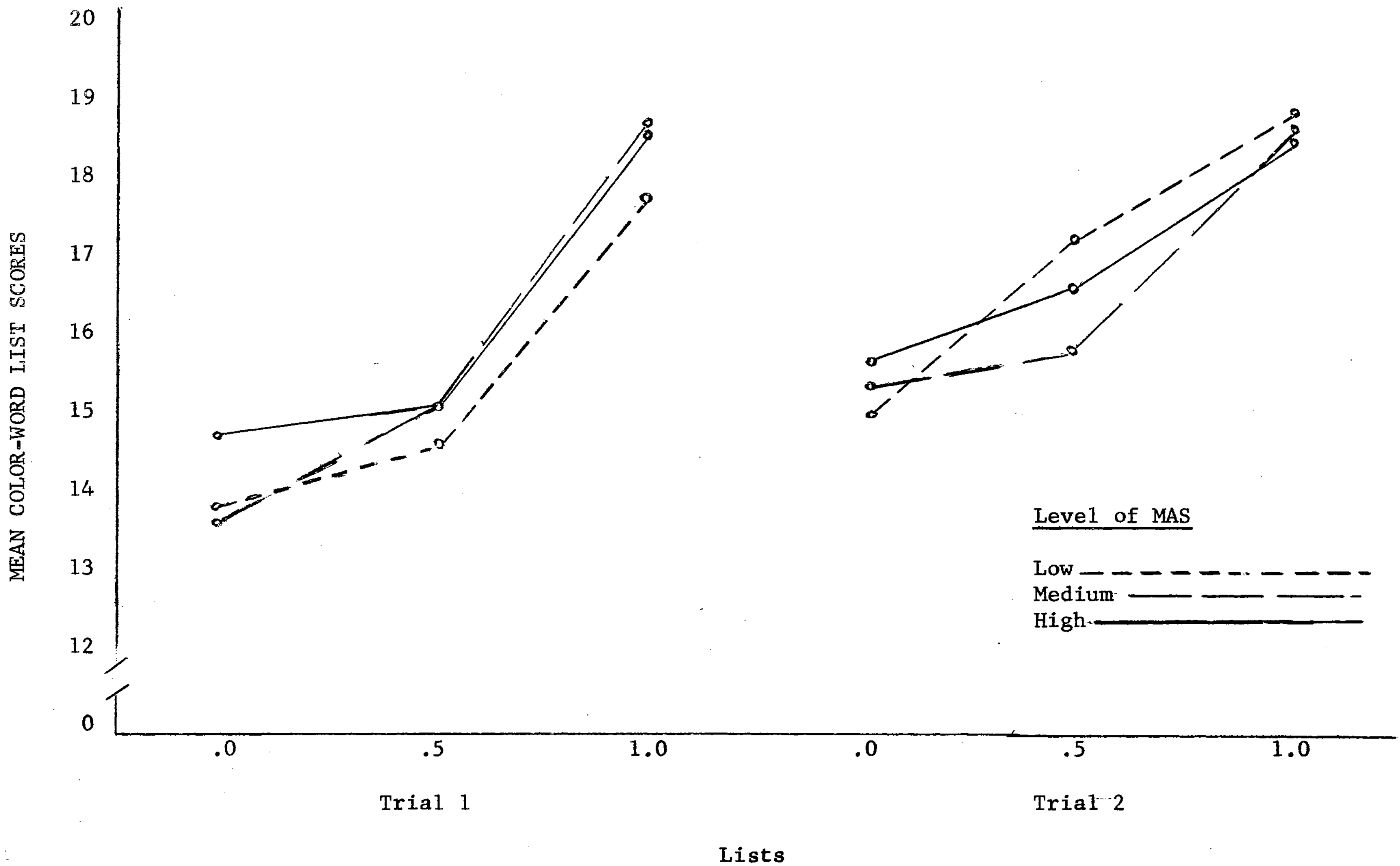

Figure 4. Uncorrected Color-Word List Performance of the Three MAS Groups

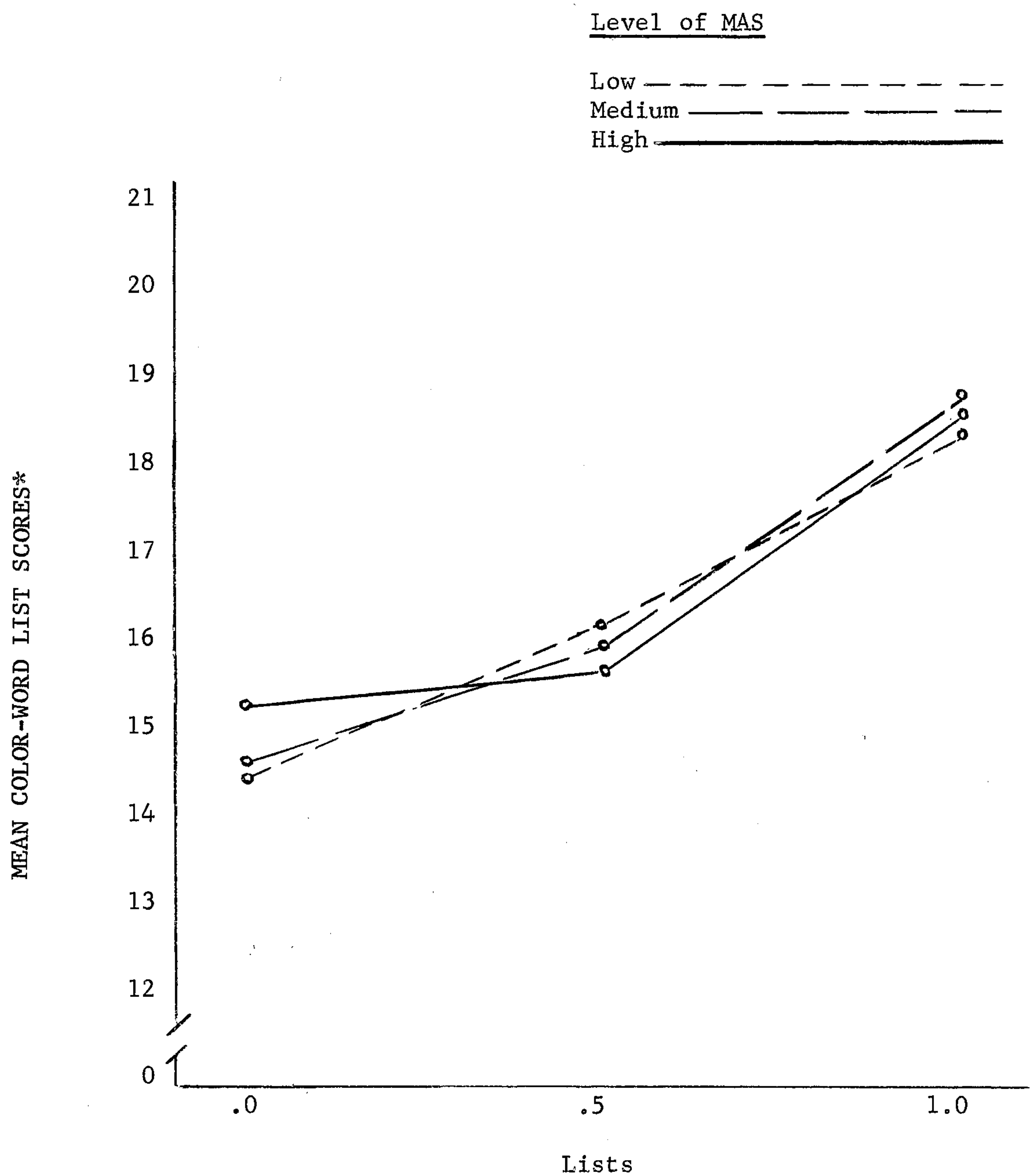

Figure 5. Overall Uncorrected Color-Word List Performance of the Three MAS Groups

*Summed over trials

performed the low anxious Ss. However, the highest performance on this list was associated with medium anxious Ss, a result similar to that seen on the second trial of the color and word lists. None of the above performance differences, of course, approached significance.

TABLE II

AOV OF SCORES ON THE WORD LIST AS A FUNCTION OF MAS AND TRIALS

Source	df	SS	MS	F
Anxiety	2	1.6759	.8380	.4146
Error (bet)	103	2081.6937	20.2106	
Trials	1	143.4073	143.4073	60.4900***
Tr. X Anx.	2	6.6760	3.3308	1.4081
Error (with)	103	248.9159	2.3706	
Between Ss	105	2083.3696		
Within Ss	106	398.9902		
Total	211	2482.3688		

***Significant beyond the .001 level

A rather unexpected finding was the significant interaction between lists and trials. This indicates that performance differences between trials were greater for some lists than for others. Inspection of Figure 4 reveals the nature of this interaction. All groups performed significantly better on lists .0 and .5 on the second trial.

For list 1.0, however, there were no significant differences between trials.

TABLE III

AOV OF UNCORRECTED SCORES ON THE COLOR-WORD LISTS AS A FUNCTION OF MAS, LISTS, AND TRIALS

Source	df	SS	MS	F
Anxiety	2	3.8982	1.9491	.1014
Lists	2	561.2314	280.6157	14.5983***
Anx. X Lists	4	11.3241	2.8310	.1473
Error (bet)	97	1864.5824	19.2225	
Trials	1	66.6667	66.6667	27.1422***
Tr. X Anx.	2	4.6944	2.3472	.9556
Tr. X Lists	2	17.1945	8.5972	3.5002*
Tr. X Anx. X Lists	4	11.1944	2.7986	1.1394
Error (with)	97	238.2488	2.4562	
Between Ss	105	2441.0361		
Within Ss	106	337.9988		
Total	211	2779.0349		

*Significant beyond the .05 level
***Significant beyond the .001 level

On the assumption that a more sensitive response measure might be the number of correct responses completed during the time interval rather than simply the absolute number of responses completed, a second analysis was performed on scores on the color-word lists using the number of responses completed without error as the unit of measurement.

Table IV presents an analysis of variance of corrected scores on the color-word lists as a function of MAS, lists, and trials. The results, in general, parallelled those found for absolute scores. Main effects for lists and trials, and the trials-lists interaction were again found to be significant, but both the main effect for anxiety and the anxiety-lists interaction remained insignificant. Inspection of Figures 6 and 7 reveals a slightly greater differentiation between lists and a somewhat greater relative improvement in performance on the second trial, but essentially the trends exhibited by the analysis of absolute scores were repeated.

Finally, an analysis was performed on derived scores representing the Stroop interference factor. The classic Stroop interference score (Jensen and Rohwer, 1966) was defined as the time required to read the color-word interference card minus the time required to read the color card, i.e., CW - C. However, the modifications inherent in the group administered form of the Stroop used in this investigation necessitated certain alterations in the form of the interference formula used. In the classic, individually administered form of the Stroop test the number of responses to each card was held constant, while the time required to read each card varied and was used as the dependent measure. On the other hand, for the form used in this study, the time allowed for responding to each list was held constant, while the number of responses to each list varied and was used as the dependent variable. Therefore, for the purposes of the present investigation, the inter-

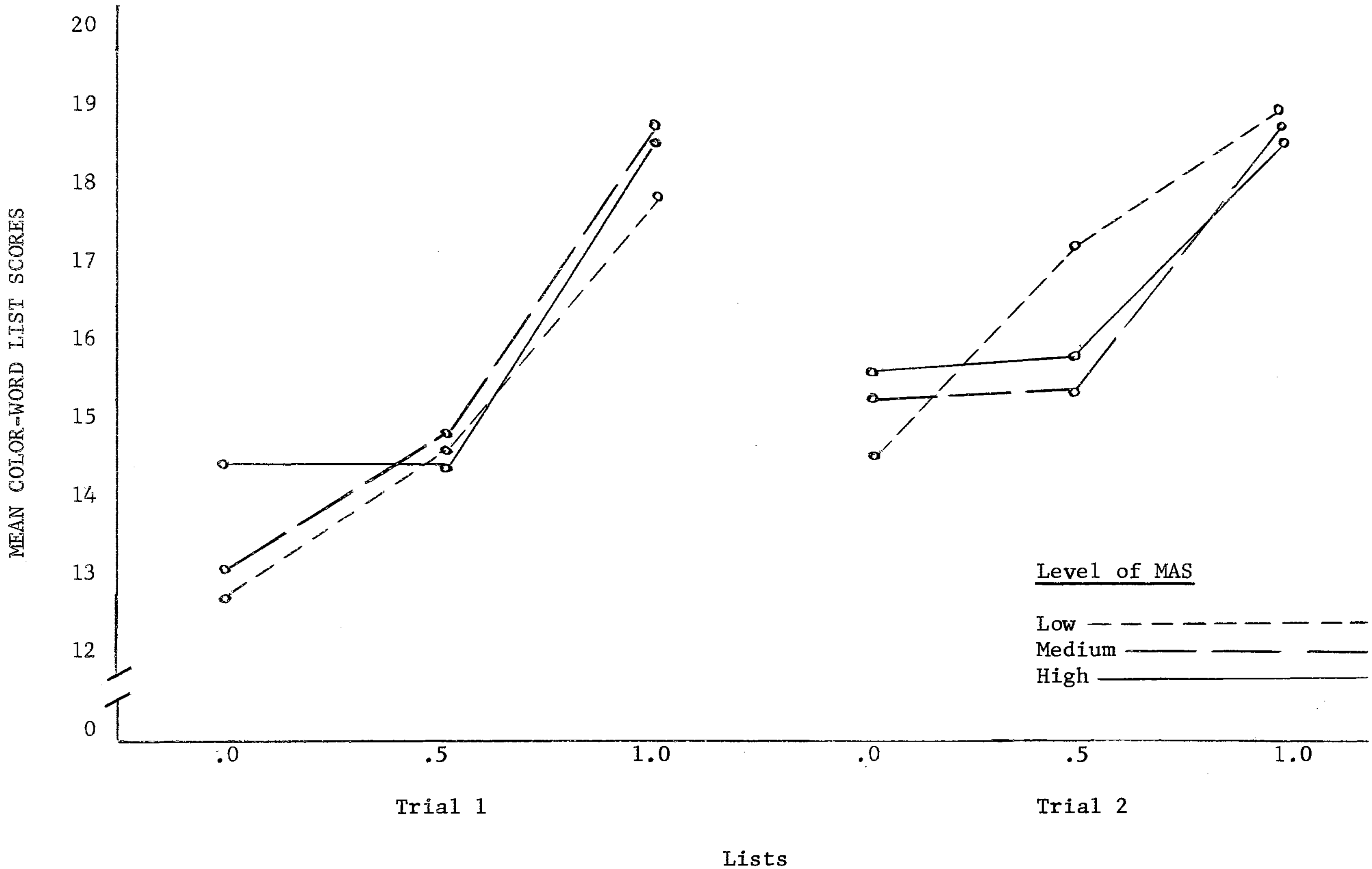

Figure 6. Corrected Color-Word List Performance of the Three MAS Groups

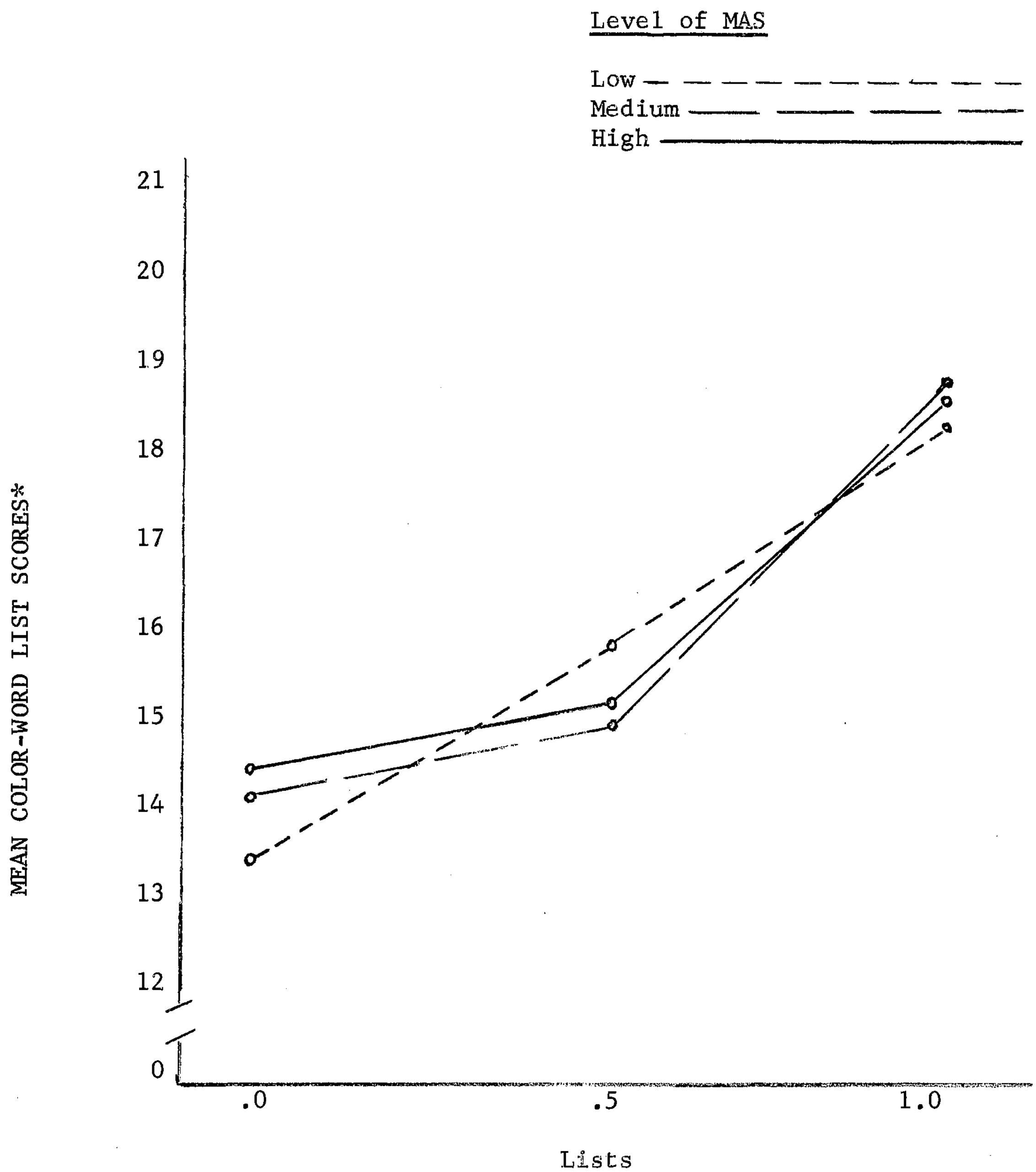

Figure 7. Overall Corrected Color-Word List Performance of the Three MAS Groups

*Summed over trials

ference score was defined as the inverse of the classic formula, that is, C - CW rather than CW - C. Theoretically, this insures that the denominator will be greater than the numerator if interference is present.

TABLE IV

AOV OF CORRECTED SCORES ON THE COLOR-WORD LISTS AS A FUNCTION OF MAS, LISTS, AND TRIALS

Source	df	SS	MS	F
Anxiety	2	3.7073	1.8559	.0903
Lists	2	733.7867	366.8934	17.8980***
Anx. X Lists	4	29.6299	7.4075	.3614
Error (bet)	97	1988.4158	20.4991	
Trials	1	78.2407	78.2407	30.8825***
Tr. X Anx.	2	10.8148	5.4074	2.1344
Tr. X Lists	2	19.3428	9.6714	3.8174*
Tr. X Anx. X Lists	4	7.8517	1.9629	.7748
Error (with)	97	245.7493	2.5335	
Between _S_s	105	2755.5397		
Within _S_s	106	361.9993		
Total	211	3117.5390		

*Significant beyond the .05 level
***Significant beyond the .001 level

Table V presents an analysis of variance of C-W interference scores as a function of MAS, lists, and trials. Significant main effects were found for lists and trials. However, the main effect for differentiating levels of MAS, as on all the previous analyses, failed to attain significance, and no interaction was significant.

TABLE V

AOV OF INTERFERENCE (C-CW) SCORES AS A FUNCTION OF MAS, LISTS, AND TRIALS

Source	df	SS	MS	F
Anxiety	2	17.0648	8.5324	1.3314
Lists	2	822.5645	411.2822	64.1776***
Anx. X Lists	4	29.3520	7.3380	1.1450
Error (bet)	97	621.6247	6.4085	
Trials	1	31.8935	31.8935	5.9999*
Tr. X Anx.	2	4.4537	2.2269	.4189
Tr. X Lists	2	5.5649	2.7825	.5234
Tr. X Anx. X Lists	4	37.9629	9.4907	1.7854
Error (with)	97	515.6241	5.3157	
Between Ss	105	1490.6060		
Within Ss	106	595.4989		
Total	211	2086.1049		

*Significant beyond the .05 level
***Significant beyond the .001 level

Figure 8 illustrates the mean interference scores of each MAS group on each list and on each separate trial. Inspection of this figure reveals a tendency for all groups to converge on the second trial, especially on lists .5 and 1.0. There was considerable inter-trial and inter-list variability between the three MAS groups, however, and no consistent trends emerged.

Figure 9 shows the overall performance of each MAS group on each list. On lists .0 and .5, the highest mean interference score was made by the low anxious group, a result clearly contrary to drive theory expectations which would predict greater interference in association with high anxious Ss. Actually, the lowest interference scores on these lists were made by medium anxious Ss, with the high anxious group occupying an intermediate position. On list 1.0 the mean scores of all groups tended to converge and there were few meaningful differences.

Letter Transformation Test

All Ss completing the color-card test also completed the letter transformation test. For purposes of later statistical analysis, however, the data from 25 Ss were randomly selected from each MAS level.

Table VI presents an analysis of variance with repeated measures of absolute scores on the letter transformation task as a function of MAS and transformations. A highly significant main effect for transformations was evidenced. Figure 10 reveals the considerable extent of this performance difference between transformations. The expected main effect for anxiety and the anxiety-transformations interaction,

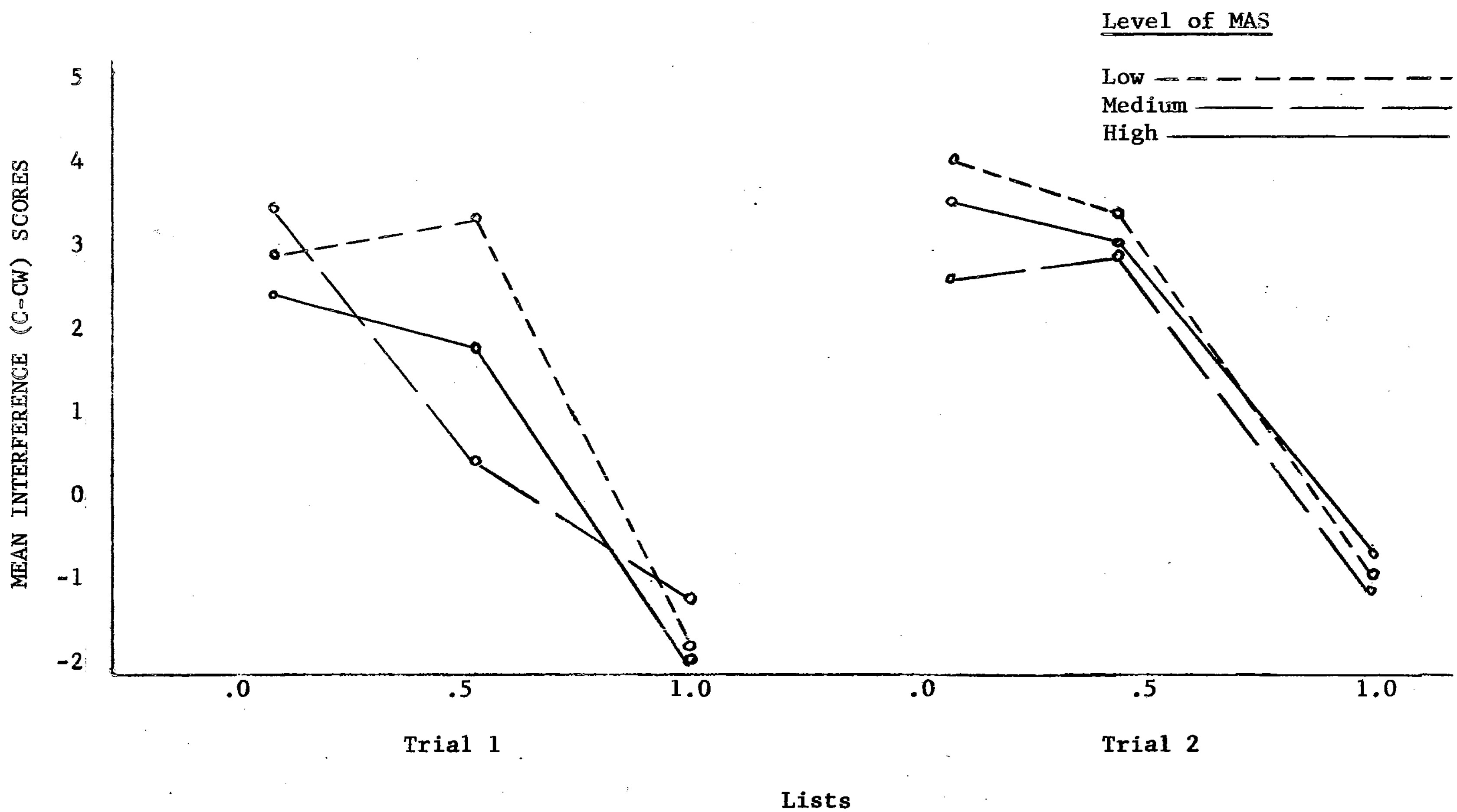

Figure 8. Performance of the Three MAS Groups on the Interference (C-CW) Variable

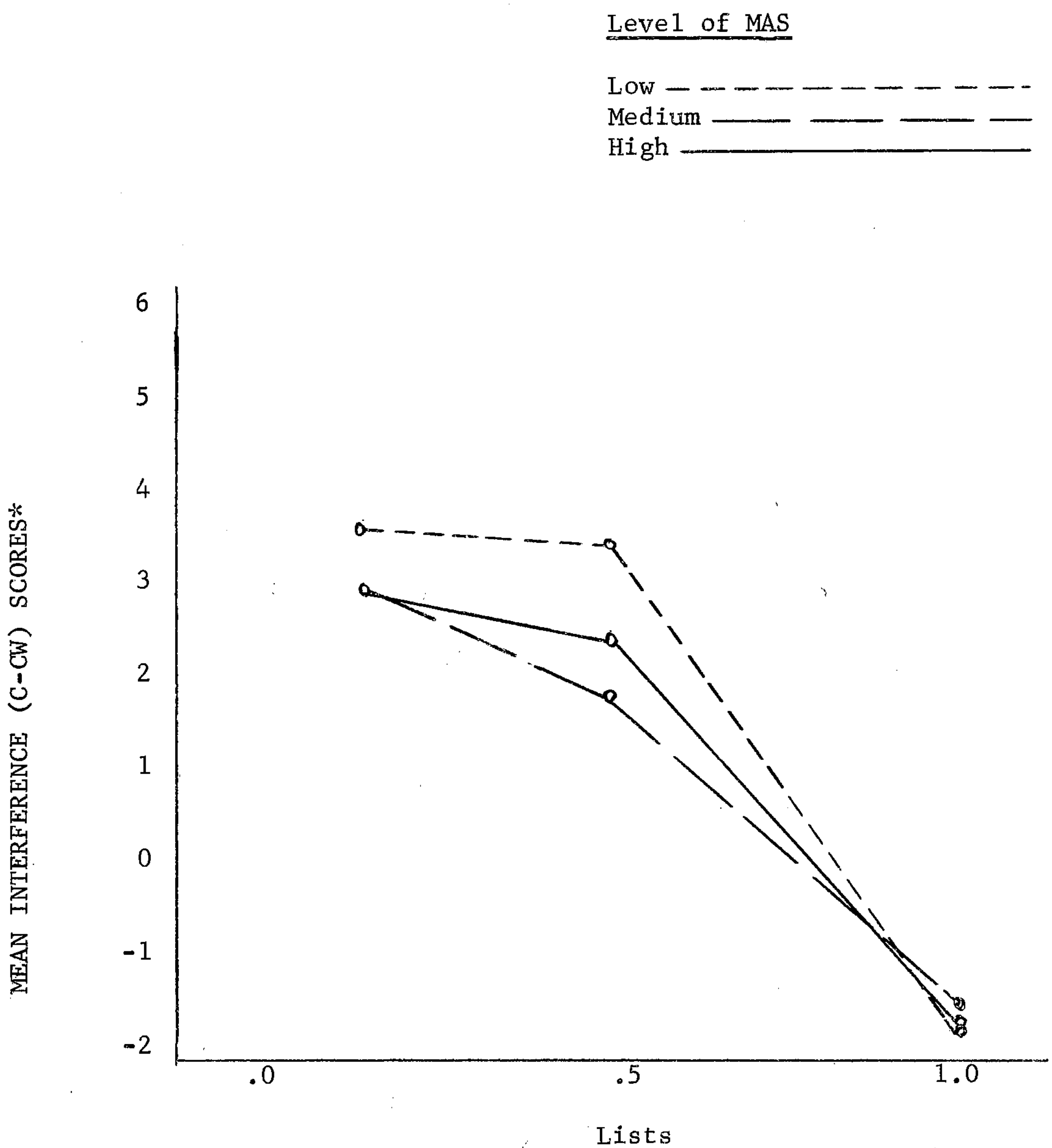

Figure 9. Overall Performance of the Three MAS Groups on the Interference (C-CW) Variable

*Summed over trials

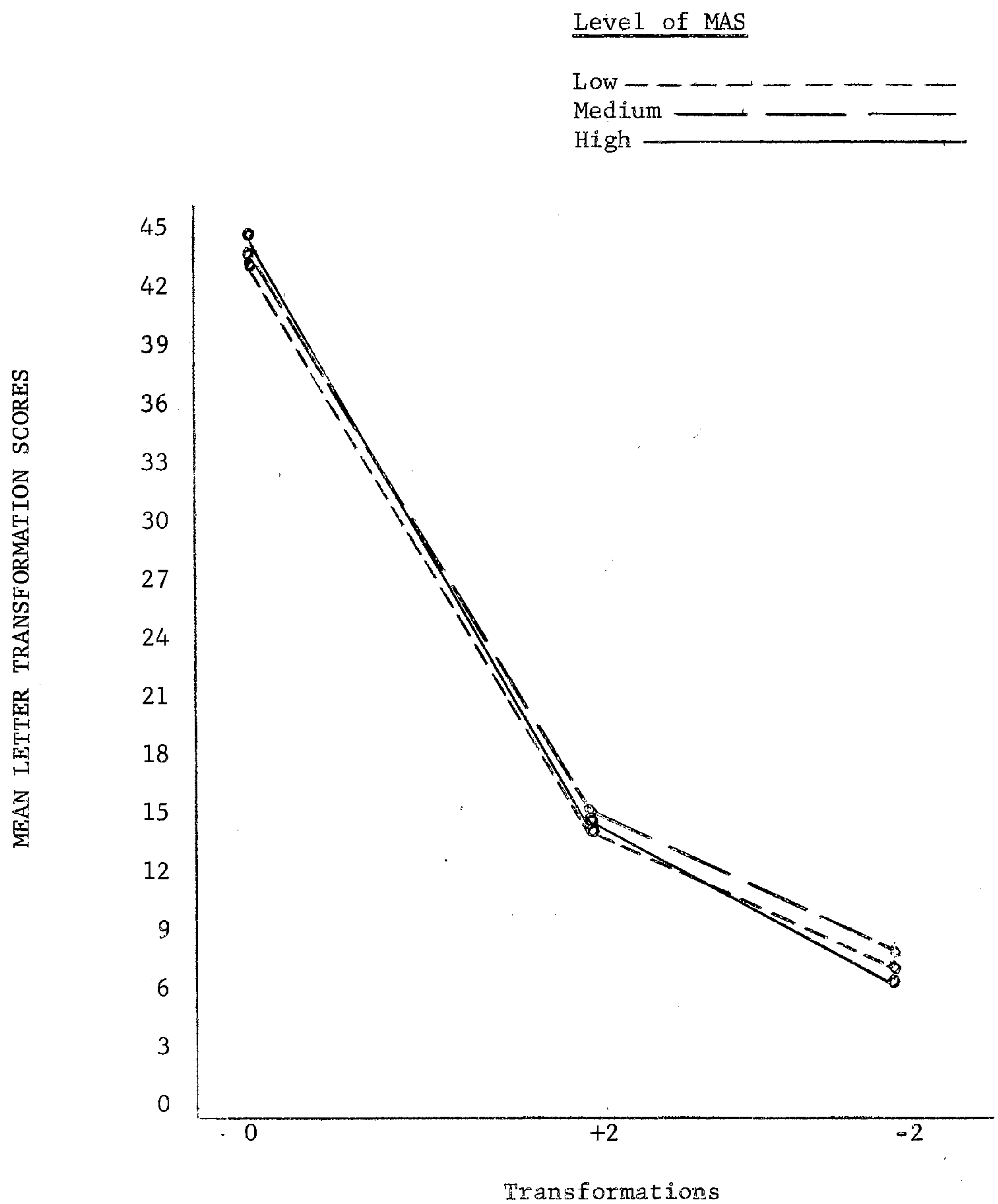

Figure 10. Uncorrected Letter Transformation Performance of the Three MAS Groups

however, fell far short of significance. Figure 10 illustrates the high degree of homogeneity between the mean scores of each MAS group on each of the transformations. In view of the very slight differences between the three MAS groups no meaningful trends could be extracted.

TABLE VI

AOV OF UNCORRECTED SCORES ON THE LETTER TRANSFORMATION TASK AS A FUNCTION OF MAS AND TRANSFORMATIONS

Source	df	SS	MS	F
Anxiety	2	6.2222	3.1111	.0853
Ss with. groups	72	2626.6660	36.4815	
Transformations	2	54937.5298	27468.7649	1457.9792***
Trans. X Anx.	4	23.4473	5.8618	.3111
Trans. X Ss with. groups	144	2712.9970	18.8403	
Between Ss	74	2632.6660		
Within Ss	150	57673.9741		
Total	224	60306.6401		

***Significant beyond the .001 level

In an attempt to obtain a measure which might be more sensitive to differences in level of MAS, a second analysis was performed on the letter transformation data, this time using the number of responses completed without error rather than the absolute number completed.

Table VII presents an analysis of variance with repeated measures of corrected letter transformation scores as a function of MAS and transformations. Although the main effect for transformations was again highly significant, the results gave no evidence of increased sensitivity to differences in level of anxiety, as both the main effect for anxiety and the anxiety-transformations interaction remained insignificant. In fact, inspection of Figure 11 reveals an even greater convergency between the mean scores of the three MAS groups than was evidenced for absolute scores. Clearly, the data do not support the prediction of an interaction between MAS and sequence of transformations.

TABLE VII

AOV OF CORRECTED SCORES ON THE LETTER TRANSFORMATION TASK AS A FUNCTION OF MAS AND TRANSFORMATIONS

Source	df	SS	MS	F
Anxiety	2	3.6356	1.8178	.0529
Ss with. groups	72	2472.2126	34.3363	
Transformations	2	58662.2754	29331.1377	1412.7930***
Trans. X Anx.	4	18.7549	4.6887	.2258
Trans. X Ss with. groups	144	2989.5977	20.7611	
Between Ss	74	2475.8482		
Within Ss	150	61670.6280		
Total	224	64146.4762		

***Significant beyond the .001 level

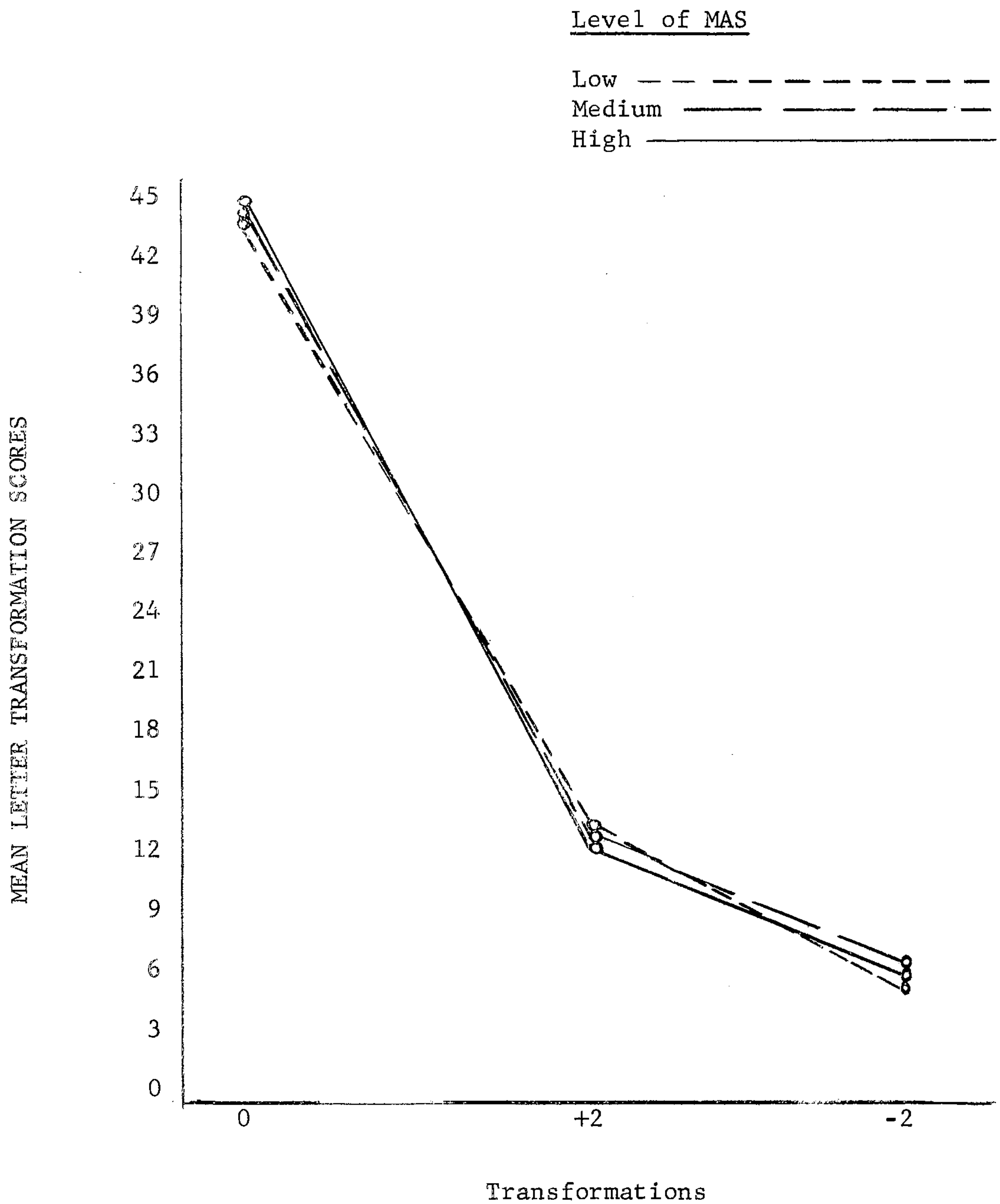

Figure 11. Corrected Letter Transformation Performance of the Three MAS Groups

CHAPTER V

DISCUSSION

As was seen in the previous chapter, the findings regarding performance of the three MAS groups on both the modified Stroop test and the letter transformation task did not support drive theory predictions. No significant differences were found between the mean scores of the three MAS groups on any of the various measures used in this investigation. Nor did any interaction involving MAS reach significance. Clearly, none of the experimental hypotheses made in Chapter II were supported by the data.

These results, at a minimum, cast considerable doubt on the generality of drive theory. Before suggesting major revisions in the theoretical structure of drive theory, however, an exploration of possible alternative explanations which might account for the results obtained by this study should perhaps be attempted. In light of this, critical attention below will be focused first upon the validity and methods of administration of the experimental tasks used in this study, and secondly, upon the use of the MAS, itself, as an instrument for selecting individuals of differing drive level.

Initial considerations will be devoted to a discussion of results touching upon the validity of the assumptions underlying the experimental tasks. It will be recalled that for the color-word interference test, the prediction that an interaction should occur between MAS and lists was based upon an assumption that the three lists differed in the amount of response competition each evoked. Clearly, for the predicted interaction to occur, however, this assumption must be valid and the three lists must actually differ in response competition. Drive theory predicts that some performance decrement should occur for all Ss despite their level of drive as an increasing function of the amount of response competition elicited by a given stimulus.[3] Therefore, since response competition on this task was assumed to be an increasing function of the number of incongruous combinations of the names of colors and colors of ink in which the names are printed, it follows that there should be some degree of performance decrement for all three MAS groups on those lists with greater numbers of such incongruities. If, however, the three lists actually did not differ in the amount of response competition each evoked, then performance differences between lists for each of the three MAS groups should be slight and statistically insignificant.

On the basis of the empirical findings of this study, assumptions of differences in the degree of response competition seem clearly upheld. Highly significant main effects for lists were found on every analysis of color-word scores, and inspection of Figures 5, 7, and 9 shows that these differences were indeed in the predicted direction, i.e., overall performance asymtopes increased as the number of color-word incongruities decreased. This indicates that all Ss found the lists increasingly difficult as the level of congruity decreased, presumably because of increasing response competition. This assumption was further supported by the observation that the overall mean perfor-

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[3]The relative amount of performance decrement, of course, would still be expected to vary according to the level of existing drive.

mance levels for the two interference lists (lists .0 and .5) were significantly lower than the corresponding mean levels for the color and word lists separately.

For the letter transformation test, roughly the same reasoning applies.[4] Predictions on this task were also based upon presumed differences in the amount of response competition evoked by each transformation. Since response competition was presumed to increase with each succeeding transformation rule in the order, 0, +2, -2 and each succeeding transformation was believed to tap a progressively weaker existing habit strength, response interference would be expected to increase and overall performance decrease, as a function of each succeeding transformation rule.

As can be seen in Tables VI and VII, the results also lent support to the above assumptions. Highly significant main effects for transformations were found, and as Figures 10 and 11 indicate, this difference was again in the predicted direction.

It seems clear from the above discussion that overall intratask differences in performance did occur on both the experimental tasks used in this investigation, and therefore failure of the tasks to function as anticipated cannot justifiably be used to account for the lack of significant differences between the three MAS groups. It is possible, on the other hand, that contamination from extraneous sources of variation introduced by the experimental procedure itself may have

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[4]For the letter transformation test, however, this reasoning is clearly open to some criticism because the nature and number of competing responses supposedly operating in the situation are not nearly as well understood as are those presumably operating on the color-word interference test.

effected the Ss in such a way that differences between the groups were reduced or eliminated. In reference to the color-word interference test, for example, since the method of administration employed in this experiment required Ss to write out their responses, rather than simply respond verbally as on the classic Stroop test, it is not known to what extent performance may have been influenced by individual differences in clerical speed and accuracy. Another possible source of undesirable variation on this task stems from the use of a projector and screen which forced Ss to perform considerable extraneous motor movements required by the necessity of alternately focusing attention on the screen and the response booklet. Finally, despite the fact that the Ss were repeatedly asked to stop immediately upon hearing the signal that terminated an experimental trial, three or four Ss were observed to continue responding after the time limit was up.

On the letter transformation task, some of the same difficulties were encountered. For this test also, considerable question arises concerning the relative influence of extraneous factors of clerical speed and accuracy in determining overall performance differences between the three MAS groups.

Thus, deficiencies in the nature of the apparatus and in the methods of administration of the two experimental tasks used in this investigation could conceivably have introduced additional sources of variation which, although not powerful enough to wipe out absolute differences between lists or between transformations, might have been large enough to mask real differences between the three MAS groups themselves on each list and each transformation separately.

Finally, it is possible that the failure to obtain significant differences between the anxiety groups in the present study may have been due to the use of the MAS itself as an instrument for selecting individuals of differing drive levels.

It will be recalled that the use of the MAS as a measure of drive was based upon the two assumptions that drive level was related to an individual's internal anxiety or emotionality, and that the paper and pencil MAS inventory was an adequate measure of this anxiety or emotionality. There are at least two theories, however, regarding the conditions under which this anxiety or emotionality is evoked. One theory adopts the view that scores on the MAS reflect a basically chronic anxiety state, so that high scorers on the MAS, for example, carry their high level of anxiety around with them constantly, manifesting it under all circumstances. This represents the view taken by the present study. The opposing view, on the other hand, conceives of scores on the MAS as primarily reflecting different potentialities or thresholds for anxiety arousal, so that high scorers on the MAS would be expected to react with greater anxiety than low scorers only in response to unusual or stress-provoking situations (Taylor, 1956). According to the first theory, performance differences should be found between different levels of MAS regardless of whether the experimental situation is stressful and anxiety provoking or not. For the second theory, however, performance differences between levels of MAS are predicted only in situations where an objective or subjective threat is involved (Taylor, 1956).

Although the available evidence supporting or refuting the above theories remains somewhat inconsistent at present, the results of at least two studies (Gordon and Berlyne, 1954; Lucas, 1952), have supported the view that anxiety as measured by the MAS is triggered only under stressful circumstances. These investigators testing high anxious (MAS) Ss under conditions of high stress (telling Ss that they had failed an intelligence test), and under more neutral, non-stressful conditions, found a significantly greater deterioriation in performance on a complex learning task for high anxious Ss tested under the stressful conditions than for high anxious Ss tested under more neutral conditions (Taylor, 1956).

On the other hand, a large number of studies have reported performance differences between high and low anxious Ss under experimental conditions apparently involving no objective stress (see Chapter I). However, as Taylor has pointed out: "to many college sophomores psychology experiments per se may be regarded as somewhat threatening, particularly when the task could be interpreted as reflecting on their personality or intelligence" (Taylor, 1956, p. 312). Because many past investigations of performance on complex learning tasks as a function of MAS, although not deliberately introducing psychological stress, have utilized rather complicated verbal materials or difficult mazes, it is quite possible that the Ss may have interpreted these tasks as somehow reflecting on their intelligence. If so, then considerable stress may have been introduced rather inadvertently, leading to poorer performance by high anxious Ss.

On the other hand, it is possible to envision experimental conditions where the use of neutral, non-stressful instructions and less threatening tasks might considerably reduce performance differences between Ss scoring at the extremes of the MAS. As Taylor herself has stated: "it is perfectly possible that in experimental arrangements involving no noxious stimulation or stress-inducing instructions which call upon skills not particularly valued by college students, differences between MAS groups might disappear" (Taylor, 1956, p. 312).

The present experiment in some ways represents such an experimental arrangement. Since the instructions used were generally non-threatening (no mention of intelligence or personality) and the experimental tasks were seemingly rather innocuous (not readily associated with intelligence or academic success), the experimental situation may not have been sufficiently threatening to produce meaningful differences in drive level between the three MAS groups. If so, then it is perhaps not too surprising that no significant differences were found between the anxiety groups on either of the experimental tasks.

The fact that many of the Ss used in this investigation were experimentally sophisticated may also have had a bearing on the results. Mednick (1957), in a study of stimulus generalization as a function of MAS, found no significant differences between high and low anxious Ss when these Ss had participated in a large number of previous experiments. Less experiences Ss, however, demonstrated the predicted performance differences between MAS groups. From these results Mednick concluded that a high score on the MAS indicates a low threshold for anxiety elicitation in a stressful situation, rather than a chronic state of anxiety, but that this low threshold could adapt out with repeated experience in the situation (Mednick, 1957).

Since the introductory psychology classes were heavily tested during the term in which the present study was carried out, a large proportion of the Ss used had participated in a number of previous studies. Therefore, it is possible that differences in drive level between the three MAS groups used in the present investigation may have adapted out with increased exposure to experimental situations in the fashion suggested by Mednick.

If, as much of the discussion seems to indicate, the experimental procedure or the nature of the apparatus and materials used in this investigation were themselves in some way responsible for the lack of significant differences between the anxiety groups, then a brief consideration of possible adjustments in the experimental design and procedure which might correct these deficiencies seems in order.

First, it seems important that future research efforts in this area pay closer attention to the type of instructions given to the Ss. Perhaps all such instructions should contain statements designed to produce at least a minimal amount of psychological stress. Thus, if as was suggested, differences in drive level between Ss scoring at the extremes of the MAS continuum are only triggered by stress-producing circumstances, then such an experimental arrangement would be more likely to produce such differences.

More specifically, in relation to the color-word interference test used in this study, it was noted previously that the modifications made in the standard Stroop design to allow for a group administration may have introduced so many additional sources of variation that the sensitivity of the test to individual differences was considerably reduced. If so, then perhaps a more sound procedure for testing drive theory predictions would be to abandon the attempt to produce a group administered version and return to the standard individually administered form discussed earlier. The classic Stroop test, although requiring considerably more time and effort in collection of data, has the advantages of more thorough standardization, more rigorous experimental control, and a highly sensitive response measure (time in seconds).

In addition, since the individually administered form of the Stroop involves a direct, one to one relationship between the experimenter and the Ss, and requires the Ss to work directly against the clock (i.e., complete a task as quickly as possible rather than do as much as he can within a specified time interval), it is possible that the standard Stroop test might be somewhat more stressful to the S than the group form used in the present investigation. Therefore, if, as was suggested previously, differences in drive as measured by the MAS are only triggered by conditions of stress, then the individually administered form of the Stroop might be expected to more readily produce such differences.

Pending further research efforts which implement the above suggestions, however, it must be concluded that the adequacy of drive theory in predicting performance as a function of MAS on the experimental tasks used in this investigation has not been successfully demonstrated.

CHAPTER VI

SUMMARY

This investigation was concerned with evaluating certain Hullian "Drive Theory" (Hull, 1943; Taylor, 1956) predictions regarding performance on a modified form of the Stroop Color-Word Test (Stroop, 1935) and a letter transformation task (Weber, Cross, and Carlton, 1968) as a function of scores on the Taylor Manifest Anxiety Scale (MAS) (Taylor, 1953).

The color-word test used was a modified form designed for group administration. It consisted of a color list, a word list, and three color-word interference lists. The color list consisted of 32 units of X's, each unit tinted one of the following hues: red, blue, green, and brown. The units were randomly laid out in a 4 x 8 matrix on a plastic transparency suitable for use with an overhead projector. The word list consisted of 32 names of the same colors printed in black and randomly laid out in a 4 x 8 matrix on a plastic overhead transparency. The color-word interference lists consisted of three 4 x 8 matrices of 32 color names printed in colored ink. The three lists differed in the number of incongruous combinations of names of colors and colors of ink used to print the names. On list .0, no word was printed in the color it named. On list .5, half the words were printed in the same color as the color they named, and half were printed in a color of ink incongruous with the color they named. On list 1.0, every word was printed in the color it named.

The letter transformation test consisted of a transformation procedure which required serial alphabetic transformations at rule specified distances from stimulus letters. Three transformation rules were used: 0, +2, -2, meaning that the Ss were required to write the same letter, the letter that occurred two letters forward, and the letter that occurred two letters backward in serial alphabetic sequence from the stimulus letter. The stimulus letters consisted of the 26 letters of the English alphabet presented in a random order.

A sample of 436 male introductory psychology students were administered the MAS. From this sample, groups consisting of low, medium, and high anxious Ss selected from among the top, middle, and bottom 60 scorers, respectively, in the distribution.

An equal number of Ss from each anxiety level were randomly assigned to each of the three color-word interference lists. In a subsequent experimental session all five color-word lists were projected on a screen for a total of twenty seconds each, and the Ss were required to respond as rapidly as possible to each list. All Ss received two trials on the color list, the word list, and one of the three color-word interference lists, order of presentation being counterbalanced between the two trials.

Immediately upon completion of the color-word test, all Ss completed the letter transformation task in the order, 0, +2, -2. Thirty seconds were allowed for each transformation, with the Ss again being asked to respond as rapidly as possible within the time limit.

In line with drive theory formulations, two hypotheses were made regarding performance on the color-word test: (1) Level of performance on the word list, and the color list will be an increasing monotonic function of level of MAS. (2) There should be an interaction between level of MAS and level of task complexity, with performance on the color-word interference lists .0 and .5 being a decreasing monotonic function of MAS, and level of performance of color-word interference list 1.0 being an increasing monotonic function of MAS. For the letter transformation task the following prediction was made: There should be an interaction between MAS and sequence of transformations in the order: 0, +2, -2, with level of performance on the 0 transformation being an increasing monotonic function of MAS, and performance on transformations +2 and -2 being a decreasing monotonic function of MAS.

For the color-word test, the results revealed significant main effects for lists and trials, and a significant trials-lists interaction. However, neither the main effect for anxiety nor the anxiety-lists interaction were significant and the experimental hypotheses were not supported. For the color and word lists, no significant differences were found between the three MAS groups on either list, a result also contrary to predictions.

For the letter transformation test, a significant main effect for transformations was found, but the predicted main effect for anxiety and the anxiety-transformations interaction failed to reach significance.

Although the results failed to support drive theory predictions, the possibility that problems associated with the experimental apparatus and procedure might also account for the insignificant results was discussed.

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APPENDIX

LETTER TRANSFORMATION TEST

A NAME ____________________

o ____	o ____	u ____
y ____	j ____	a ____
e ____	q ____	o ____
p ____	w ____	p ____
t ____	t ____	y ____
g ____	u ____	n ____
k ____	z ____	w ____
i ____	x ____	j ____
r ____	d ____	b ____
z ____	r ____	x ____
f ____	e ____	s ____
u ____	f ____	i ____
o ____	p ____	q ____
d ____	c ____	l ____
n ____	s ____	c ____
h ____	h ____	f ____
b ____	n ____	t ____
w ____	b ____	z ____
q ____	y ____	e ____
m ____	k ____	h ____
s ____	l ____	r ____
a ____	i ____	d ____
j ____	g ____	v ____
x ____	v ____	k ____
v ____	a ____	m ____
l ____	m ____	g ____

B

l ____	m ____	g ____
i ____	a ____	m ____
x ____	v ____	k ____
j ____	g ____	v ____
a ____	i ____	d ____
s ____	l ____	r ____
m ____	k ____	h ____
q ____	y ____	e ____
w ____	b ____	z ____
b ____	n ____	t ____
h ____	h ____	f ____
n ____	s ____	c ____
d ____	c ____	l ____
o ____	p ____	q ____
v ____	f ____	i ____
f ____	e ____	s ____
e ____	r ____	x ____
r ____	d ____	b ____
i ____	x ____	j ____
k ____	z ____	w ____
g ____	u ____	n ____
t ____	d ____	y ____
p ____	w ____	p ____
z ____	q ____	o ____
y ____	j ____	a ____
c ____	o ____	u ____

C

l _____	m _____	g _____
v _____	a _____	m _____
x _____	v _____	k _____
j _____	g _____	v _____
a _____	i _____	d _____
s _____	l _____	r _____
m _____	k _____	h _____
q _____	y _____	s _____
w _____	b _____	z _____
b _____	n _____	t _____
h _____	h _____	f _____
n _____	s _____	c _____
d _____	c _____	l _____
o _____	p _____	q _____
v _____	f _____	i _____
f _____	e _____	s _____
e _____	r _____	x _____
r _____	d _____	b _____
i _____	x _____	j _____
k _____	z _____	w _____
g _____	u _____	n _____
t _____	d _____	y _____
p _____	w _____	p _____
z _____	q _____	o _____
y _____	j _____	a _____
c _____	o _____	u _____

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