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The relationship of M.A.S. score and amphetamine to verbal and motor tasks

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THE RELATIONSHIP OF M.A.S. SCORE AND AMPHETAMINE TO VERBAL AND MOTOR TASKS

by

Martin Weitzner

(A.B., New York University, 1956;
A.M., Boston University, 1958)

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Approved by

First Reader .... L. J. Reyna
Professor of Psychology

Second Reader................................. Garry Margolius
Professor of Psychology

Third Reader.................................. [illegible]
Professor of Psychology

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CHAPTER I

INTRODUCTION

There is considerable evidence demonstrating that change in drive level leads to change in performance. While most studies concerned with the relationship between drive and performance have employed a single drive state, a few studies have examined the effects of the simultaneous action of two or more drive states on behavior.

The majority of studies relating one or more drives to performance have utilized animal subjects, primarily because of the relative ease of manipulating and controlling the relevant drive variables with these subjects. Two techniques, one old and one rather recent, have been employed to study the relationship between drive and performance in humans. Studies of the relationship between induced muscular tension and performance go as far back as 1927. Moderate degrees of muscular tension have revealed facilitating effects upon a wide variety of behavior. (See Courts, 1942). Recently Spence, 1956, and his associates have suggested a new technique for investigating the relationship between drive level and performance in human subjects. They assume that individual differences in drive level can be distinguished on the basis of subjects' scores on the Manifest Anxiety Scale, hereafter referred to as M.A.S., an inventory designed to measure manifest anxiety. Spence and his associates assume that manifest anxiety as measured by the M.A.S. is functionally equivalent to drive. They arrived at this interpretation after noting the similarity of behavioral relationships obtained in animal studies of drive and M.A.S. levels and performance. Their procedure is to select subjects with high and low drive, (as measured by the M.A.S.), and then study the differences in performance of these two classes of subjects.

The present study proposes to explore a third procedure for the manipulation of drive level through the use of drugs. In addition it proposes to determine the existence of drive summation by using subjects who are already different in general drive level, as defined by score on the M.A.S. with an without the presence of a drug. The present study will examine whether the effects of M.A.S. level and amphetamine separately and in combination parallel the functional relationships discovered in earlier animal and human studies.

CHAPTER II

REVIEW OF PREVIOUS LITERATURE

Learning and performance as a function of a single drive state. Psychologists have distinguished between two classes of drive states, acquisitional and aversive. The first type, acquisitional drives, are operationally specified by the deprivation of materials required by the organism. The second type, aversive states, have been produced by the introduction of some form of noxious stimulation, i.e., shock, intense heat, or light.

Some studies that have been concerned with the relationship of response strength and performance as a function of conditions producing primary acquisitional drives will first be reviewed.

Perin, 1942, and Williams, 1938, employing a bar pressing response, trained rats on a 23 hour deprivation schedule. The animals were then subjected to experimental extinction under 3 or 22 hours hunger drive. They found that resistance to experimental extinction was functionally related to the number of hours of deprivation. Animals under a 22 hour hunger drive made far more responses to extinction than did animals under the 3 hour condition. In a similar study by Yamaguchi, 1951, different groups of animals were subjected to experimental extinction under 3, 12, 24, 48, and 72 hours of food privation. Yamaguchi found that the number of responses to extinction increased as a function of the number of hours of deprivation and could be represented by an S shaped curve.

Horenstein, 1951, studied the functional relationship between hunger drive and the following measures: 1) latency of response following training, 2) resistance to experimental extinction. She found for both measures that there was a sharp rise in response strength between o and 2 hours hunger drive followed by a more gradual increase to 23-1/2 hours hunger drive. In a study by Kimble, 1951, a number of deprivation points were sampled and, in addition, the effects of pre-feeding upon performance were investigated. Kimble found that pre-feeding slows up the speed of responding and deprivation leads to faster reactions, i.e., response times. In an investigation by Ramond, 1954, the relationship between acquisition of an instrumental bar-touching response and two levels of hunger were studied. Ramond found that the 22 hour hunger group made more bar responses than the group under the 4 hour hunger condition.

Fredenburg, 1956, examined the relationship between the performance of a simple instrumental response and two levels of hunger drive. Two groups of rats were trained to run down a four foot alley for food. One group received this training after three hours of food deprivation, the other after 22 hours of food deprivation. Fredenburg demonstrated that the group under the 22 hour hunger drive was superior to the 3 hour deprivation group in both starting and running speeds.

The studies reviewed above point to the conclusion that consummatory activities, as well as resistance to experimental extinction of responses instrumental to consummation, tend to be enhanced by increased deprivation.

The experimental literature relevant to aversive drive states includes a study by Kaplan, 1952. He trained rats to escape bright light by pressing a bar, and found an increasing rate of responding up to approximately 180 milliamberts, after which the rate of responding diminished. Campbell and Kraeling, 1953, found that performance in an escape situation is facilitated by increasingly strong shock. Ketchel, 1955, also employed an instrumental escape conditioning situation. But in order to escape shock, animals were required to run down a four foot alley, the floor of which contained a charged electric grid. Ketchel demonstrated that running speed increased with increases in intensity of shock. These latter studies suggest that under certain conditions aversive stimuli up to optimal intensities, can serve as a primary source of drive in the performance of instrumental acts.

Experimentation in classical defense conditioning further support the proposition that response strength during acquisition and extinction is functionally related to the intensity of the unconditioned stimulus. For example, in a study by Passey, 1948, it was shown that the frequency of conditioned eyelid responses increased as a function of the intensity of the air puff. Spence and Taylor, 1951, and Spence, 1953, have demonstrated that different intensities of air puff lead to differences in the percentage of conditioned responses, with greater intensities of air puff, up to a point, resulting in a greater percentage of conditioned responses. The above cited studies demonstrate a functional relationship between a single drive level, as produced by deprivation or aversive stimulation, and level of performance as measured by strength, percentage, and latency of response during acquisition and extinction.

The relationship between two or more drives and performance. In the past twenty years, investigators working out of a Hullian-Spence framework have conducted studies in this area, referring to them as drive summation, drive combination, or the effects of irrelevant drive. Webb, 1949, was concerned with whether the presence of a need, thirst, would increase resistance to extinction of a response learned under a hunger drive. Animals under a 22 hour hunger drive were trained to obtain food by pushing open a panel. After initial training they were divided into five groups and run in an extinction series. Webb found that thirsty animals continued to perform the response longer than animals which were neither hungry or thirsty. He also demonstrated that the more severe the thirst drive the greater the resistance to extinction of the response learned under hunger deprivation. A study by Kendler, 1945, suggests that the phenomenon of drive combination is not a simple one. Kendler compared response strength under different conditions of hunger and thirst. Water deprivation was systematically varied for different groups while the hunger drive was kept constant at 22 hours food deprivation. Kendler found that the number of responses made by the 0, 3, 6, and 12 hour water deprived groups increased, but that the number of responses decreased for the group under the condition of 22 hours water deprivation.

A study by Siegal, 1946, provides support for Kendler's findings. In this study the combination of a thirst drive based upon 22 hours food deprivation led to slightly less resistance to extinction than did a single drive based upon 22 hours food deprivation. Some of the difficulties of arriving at a clear-cut experimental analysis of the effects of two simultaneous drives have been pointed out in the study by Verplanck and Hayes, 1953. Their study suggests that consummatory activities, either of eating or drinking, are reduced by the arousal of the opposite need. They found that rats that had been without food and water for 21 $\frac{1}{2}$ hours did not consume a significantly greater amount of food than animals that had been only without food. It was also shown that thirsty and hungry animals drank less water than did rats that were only thirsty.

In an investigation by Amsel, 1950, the effects of combining a hunger drive to an aversive drive, escape from shock, were studied. In part one of this study Amsel measured the effects of combining the hunger drive and the drive to escape shock upon response strength. The addition of the hunger drive did not increase speed of running. When, however, subjects were run the following day without shock, but under a conditioned fear drive, there was evidence for drive summation.

Supporting evidence for Amsel's findings come from a study by Merryman, 1952. He demonstrated that the startle response in rats was more amplified by a combinationof hunger and conditioned fear than by either acting separately.

Only a few studies of drive summation employing human subjects have been reported. Meyer and Noble, 1958, investigated the summated effects of manifest anxiety and induced muscular tension upon the performance of a verbal maze. Their principal finding was that the performance of low M.A.S. subjects tended to improve under conditions of induced muscular tension, while the performance of high M.A.S. subjects tended to deteriorate under conditions of induced muscular tension. Franks, 1957, studied the acquisition and extinction of eyelid responses in non-deprived subjects and in subjects who had gone without food, water and tobacco for 22 hours. This study failed to find empirical relationships supporting a drive summation theory.

The evidence of the studies cited in the above section suggests, though not conclusively, that under certain conditions drive states do combine to produce effects in the same direction, but greater than those produced by a single drive.

<u>Drugs and Performance</u>. During the last ten years, there has been an increasing interest in the effects of drugs on learning and performance. Drugs have been shown to enter into functional relationships with various performance criteria in both animal and human studies. For some drugs at certain levels of dosage, these relations parallel those uncovered by the manipulation of drive states produced by acquisitional or aversive drive states in animal studies. In a study by Switzer, 1935, the effects of caffeine upon the conditioned G.S.R. in human subjects was examined. Switzer demonstrated that caffeine increased resistance to experimental extinction, as well as increasing the amplitude of the unconditioned G.S.R. and decreasing the latency of reaction time.

Earlier, Pavlov, 1927, reported a study in which the administration of a caffeine solution served to dissipate the effects of extinction.

A study by Miller and Miles, 1935, demonstrated more systematically the relationship between caffeine and certain performance criteria. They found that the injection of caffeine sodio-benzoate in albino rats served to reduce the locomotor retardation due to experimental extinction by about two thirds. The injection of caffeine also reduced the retardation in locomotor time due to satiation. Skinner and Heron, 1937, found that benzedrine greatly retarded the onset of experimental extinction in rats.

The relationship of drugs to performance has perhaps been most extensively studied with the drug amphetamine. Peoples and Guttman, 1936, found that amphetamine facilitated speed of coding. Barmark, 1938, found that amphetamine increased speed of adding when subjects worked continuously for two hours. Andrews, 1940, studied the effects of amphetamine upon syllogistic reasoning. Using a counter-balanced drug design, Andrews found that amphetamine subjects had superior accuracy and time scores than did placebo subjects. Welch et. al., 1946, found that amphetamine facilitated the retention of low association nonsense syllables. In a study by Kleemier and Kleemier, 1947, the effects of amphetamine upon a wide variety of psychomotor tasks was examined. They found that amphetamine facilitated performance on such tasks as simple addition, multiplication, and subtraction, as well as certain coding tests. Eysenck et. al., 1957, studied the effects of amphetamine upon a simple motor task, the pursuit rotor. Amphetamine facilitated performance on this task. Willet, 1958, investigated the effects of amphetamine on a verbal learning task. Using the serial anticipation method, he presented a list of low association nonsense syllables to amphetamine and placebo subjects. Willet found that the amphetamine group reached criterion more rapidly than did their placebo counterparts. Franks and Trouton, 1958, investigated the effects of amphetamine on the acquisition and extinction of the eyeblink response. They found that amphetamine subjects made many more conditioned responses during acquisition and extinction than did placebo subjects. Smith et. al., 1963, studied the effects of amphetamine on the performance of a simple digit letter coding test. This list was similar to the coding tests employed by Peoples and Guttman, 1936, and Kleemier and Kleemier, 1947. Smith et. al., found that amphetamine facilitated performance on the coding test.

Indirectly related to the above studies are a number of investigations which have been concerned with the relationship between amphetamine and mood states. Barmark, 1938, found that the administration of amphetamine retarded the onset of reports of boredom and fatigue. Tyler, 1947, reported that amphetamine subjects had less difficulty in remaining awake for long periods of time as compared with their placebo counterparts. Payne and Hauty, 1954, found that amphetamine subjects had a more favorable attitude toward prolonged work. In a study by Smith and Beecher, 1960, subjects reported an increased feeling of mental and physical activation after the administration of amphetamine.

The literature reviewed in this last section suggests that within a certain dosage range, amphetamine facilitates the performance of subjects on a wide variety of tasks. There is also considerable evidence that amphetamine has a profound effect upon the subjective report of mood. Subjects after the administration of amphetamine report increased activation, energy, etc.

M.A.S. as a measure of drive and performance. Until recently the investigation of the functional relationships between level of drive and performance rested almost entirely in animal studies were conditions could be more easily manipulated. The development by Taylor, 1951, of the Manifest Anxiety Scale, appears to have provided one technique for describing drive level in man. The basic assumption made by Taylor, 1951, and Spence and Taylor, 1951, is that individual differences in level of general drive can be usefully defined in terms of the response of subjects to questionnaire items purporting to reflect manifest anxiety. The M.A.S. was constructed in the form of a questionnaire type personality inventory. Adapted from the Minnesota Multiphasic Personality Inventory, it contains questions which clinical psychologists judged would elicit answers indicative of manifest emotionality or anxiety. Although M.A.S. scores have been shown to correlate highly with psychiatric judgments of manifest anxiety as well as other criteria, these correlations are irrelevant to the aim of most experimental psychologists who have employed the M.A.S. For the most part, these investigators have simply defined drive level in terms of M.A.S. scores.

The earliest studies utilizing M.A.S. scores as a measure of drive were performed in the area of classical defense conditioning. In a study by Taylor, 1951, high and low M.A.S. subjects were run under identical conditions in an eyelid conditioning situation. Taylor found that high M.A.S. subjects made more conditioned eyelid responses during acquisition than did low M.A.S. subjects. Spence and Farber, 1953, in a study similar to that of Taylor, 1951, found that high M.A.S. subjects made more conditioned responses during conditioning and extinction than did low M.A.S. subjects. There are a number of additional studies emmanating from the Iowa laboratory which confirm the relationships found in the earlier studies.

In complex learning situations according to Spence, 1956,

> "...the effect of drive level variation will depend on a number of different factors to which careful consideration must be given. Particularly important are the presence and the direction of the differences in the habit strengths of the competing responses.

> If the experimental situation does not develop differences in the habit strengths, then drive variation will not affect performance. If there is a difference in habit strength in favor of the correct response over the incorrect response or responses, then the higher the drive the better the performance. If, on the other hand, the correct response has a lower habit strength than competing response or responses then high drive will be detrimental to performance."

In the earlier studies designed to investigate the relationship between M.A.S. score and performance in complex situations, verbal, (serial learning), and motor tasks, (finger mazes), were employed.

Farber and Spence, 1953, investigated the performance of high and low M.A.S. subjects on a task involving response competition, (a ten choice stylus maze, in which the level of difficulty had been previously established). They found that high M.A.S. subjects made more errors and required more trials to reach criterion than did low M.A.S. subjects. The authors reported that the differences between high and low M.A.S. subjects tended to be greatest at the more difficult choice points and smaller at the less difficult choice points.

Taylor and Spence, 1952, employing a form of serial verbal maze, assumed that errors on this task would result from interference from response tendencies derived from remote associations, and predicted that high M.A.S. subjects would make more errors and require more trials to criterion than would low M.A.S. subjects. This prediction was confirmed at a significant level. Axelrod, Cowen, and Herlizer, 1956, replicated the Farber Spence study. They found that high M.A.S. subjects made more errors and required more trials than did low M.A.S. subjects but these differences were not statistically significant. Montague, 1953, using nonsense syllables and the method of serial anticipation predicted that as the association value of items increased and the inter-item similarity decreased, or as the ratio of potentially correct to incorrect responses increased, there would be a relatively greater increment in performance measures for high M.A.S. subjects than for low M.A.S. subjects. Montague found, a) that high M.A.S. subjects were superior to low M.A.S. subjects on a list of low similarity and high association value, and b) that low M.A.S. subjects were superior on a list of high similarity and low association value and a list of low similarity and low association value, but these latter differences were not statistically significant. Ramond, 1953, attempted to control the number and strength of competing responses in a verbal performance task. He constructed his task in such a way that the subject could respond to each of a series of stimulus words with either of two given response words. The response words were selected so that one was relatively high in the initial response hierarchy and the other relatively low, e.g., stimulus word - tranquil - response words, serene, relatively high in the subjects initial response hierarchy, response word, ragged, relatively low in the subjects initial response hierarchy. Ramond observed performance on two kinds of presentations. In the first, the stronger of the two responses was correct and the weaker incorrect. In the second, the weaker of the two responses was correct and the stronger incorrect. The learning method involved choice rather than anticipation of the correct response. Ramond found that on those presentations in which the weaker response was correct the low M.A.S. subjects responded correctly more often than did the high M.A.S. subjects. On those presentations in which the stronger response was correct no statistically significant difference between the performances of the two groups was found.

Standish and Champion, 1960, presented high, middle and low M.A.S. subjects with an easy paired-associates list followed by a difficult paired-associates list. They were concerned with latency of response and took the following measures: for the easy list the latency of response for the first two errorless trials and the following eight trials; for the difficult list the latency of response for the first ten trials and the following eighttrials. They found that high M.A.S. subjects had shorter latency of response times on the easy list as compared with low M.A.S. subjects. Standish and Champion also found that low M.A.S. subjects had shorter latency of response times on the difficult list, as compared to high M.A.S. subjects.

Spence, Farber and McFann, 1956, investigated the relationship between drive level and performance in competitional and non-competitional paired-associates learning. High M.A.S. subjects were significantly superior to low M.A.S. subjects on the non-competitional paired-associates list and low M.A.S. subjects were superior to high M.A.S. subjects on the competitional list. Spence, Taylor and Ketchel, 1956, in a subsequent study, combined performance on a competitional and non-competitional list into a factorial design with the purpose of determining whether the interaction between anxiety level and performance on the two types of paired-associates list would be statistically significant. An analysis of variance for this interaction gave a statistically significant F value.

The studies cited in the above section support the conclusion that M.A.S. score enters into functional relationship with performance on a wide variety of performance criteria ranging from classical defense conditioning situations to complex verbal learning situations.

STATEMENT OF PROBLEM

As was indicated in the literature reviewed, the functional relationships between two simultaneous drives and performance have been studied, but with few exceptions these studies have not employed human subjects. Moreover, previous drug studies as well as M.A.S. studies have been confined to a single task. In addition, M.A.S. studies have traditionally employed an experimental design utilizing independent subject samples performing on simple and difficult tasks.

Accordingly, the present study proposes to combine two drives, i.e., M.A.S. score and amphetamine in human subjects. It further proposes to test for the separate and combined effects of M.A.S. score and drug upon the learning and performance of several tasks, each at both simple and complex levels. The study plans to focus specifically on the following experimental issues:

1) The nature of the relationship between M.A.S. score and the learning and performance of a variety of simple and complex tasks performed by the same subjects.
2) The extent to which amphetamine alone affects the learning and performance of these same tasks.
3) The nature of inter-relationships between the following variables: a) type of learning material, b) drug, c) M.A.S. score.
4) The nature of the combined effects of two drives on performance of the various tasks.

CHAPTER III

METHOD

Subjects: The experimental plan involved the assignment of subjects to high, middle and low anxiety groups on the basis of their score on the M.A.S. Four hundred and twenty male undergraduate students at Boston University were screened with the M.A.S., which was described to the subjects as a Biographical Inventory.* From this population 96 subjects were selected for the experiment.** Table I gives the data with respect to the M.A.S. scores of the three groups selected. The range of M.A.S. scores for the three groups is identical to the more rigorous differentiations made by Spence, Taylor, etc.

TABLE I. ANXIETY SCORES ON THE M.A.S.

Group	Mean Score	Median Score	Range
High M.A.S.	25.5	24	21 - 36
Middle M.A.S.	14.8	14	12 - 17
Low M.A.S.	4.4	5	1 - 7

A score of 7 or below, or 21 or above, corresponds to the lower and upper 20% of the M.A.S. Distribution of scores for College Students. A score of 13 falls at the fiftieth percentile on the Distribution.

The M.A.S. scale also yields a "lie" score. Individuals with a lie score of 6 or above were not accepted as subjects for this study. Half of the subjects in each of the three M.A.S. groups received amphetamine

* See appendix 1 - for biographical inventory and method of scoring.

** All subjects were medically screened regarding the drug by Staff physicians from Mass. General Hospital before being accepted for the experiment. Subjects under 21 years of age were required to obtain parental consent.

14 mg/70 kg of body weight, which was taken orally 2 hours prior to the experimental session. The other half received visually identical placebo capsules also taken two hours prior to reporting for the experimental session. All subjects were told that they would receive a stimulant of the amphetamine family. The two hour period between drug administration and beginning of experimental session and dosage level were chosen on the basis of earlier work (See Weiss and Laties, 1962).

TASKS AND APPARATUS

Performance on three kinds of tasks, paired-associates learning, digit-letter coding, and rotary pursuit, was obtained from all subjects. These tasks, sub-tasks, associated equipment and instructions are presented below.

TASK I. PAIRED-ASSOCIATES LEARNING

This task consisted of two different parts: a "simple" or "non-competitive" and "difficult" or "competitive" list.

A) The simple paired-associates list consisted of fifteen pairs of stimulus and response words. (See appendex II. a.). This list was constructed to meet the following criterion stated by Spence: 1) each stimulus word was paired with a response word with which it is highly associated, 2) the associative connection between each stimulus word and all response words (except the one for which it is the stimulus) is low, 3) no stimulus word was synonymous with any other stimulus word, and no response word was synonymous with any other response word. (To further reduce the possibility of intra-list synonymity, care was taken that no two stimulus, and no two response words begin with the same letter), and

4) to prevent the development of remote associations, the pairs were presented in three different orders. B) The difficult paired-associates list consisted of 12 pairs of stimulus and response words. (See appendix IIb).

The twelve stimulus-words in appendix II b are composed of four groups, each group consisting of three highly associated words. In each group, one stimulus-word is paired with a response-word which is highly associated with all three stimulus-words in that group. The remaining two stimulus-words are paired with response-words of little or no associative strength. The following triad is an example:

fearless	daring
gallant	winged
valiant	burly

Apparatus: same as in I a.

Instructions: same as in I a.

In this triad, fearless is paired with a highly associated response - daring, while gallant and valiant are paired with response-words of weak association. Since gallant and valiant have a high initial associative connection with daring, the learning of the associations gallant-winged and valiant-burly would involve a strong competing response tendency.

Apparatus - A Hull-type memory drum (Lafayette Model #303B) was employed to present the lists of paired-associates. The successive stimulus items were exposed every 4 seconds with a 4 second interval between the successive presentations of the list. A 2 second anticipation interval was employed.

TASK II. DIGIT LETTER CODING*

This task consisted of two different parts: a "simple"* and "difficult"** test.

a) The simple test consisted of 20 lines of material such as the following: 4 d p q r N d B 7 W b g J p 6 E m N a 5 Z v p L k f h B t 2 V W m. At the top of the page a code such as the following appeared: 2 - circle large letters; 3 - underline small letters; etc.

Instructions - The subject was asked to respond to the letters which followed a given number, using the operation for which that number was the symbol.

b) The difficult coding consisted of the same material as above. The instructions, however, were modified to read as follows: "whenever you see an odd number (1, 3, 5, 7) do <u>not</u> respond to the <u>first</u> otherwise appropriate letter in each block."

"Whenever you see an even number (2, 4, 6) do <u>not</u> respond to the <u>last</u> otherwise appropriate letter in each block."

"When there is only one appropriate letter in a block do not respond to that letter."

TASK 3. ROTARY PURSUIT

Each subject had five two-minute trials on the pursuit rotor.

Apparatus - The pursuit rotor test consisted of a modified phonograph turntable which revolved at 33 rpm. The target was a metal disc $\frac{1}{2}$ inch diameter inserted in a bakelite disc. The target was $3\frac{1}{2}$ inches from

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* See appendix II c for simple coding test.

** See appendix II d for difficult coding test.

the center.

Experimental Design: As was mentioned earlier, the 96 experimental subjects were assigned to three M.A.S. groups, each consisting of 32 subjects. Within each M.A.S. group there was a further subdivision: 16 subjects received amphetamine and 16 received placebo. In each group of 16 subjects, 2 subjects received tests in one order, 2 in another, 2 in another, etc. There were 8 test orders altogether. The use of 8 test orders permitted us to examine for interactions among test order, M.A.S. level, and drug. Analyses of variance revealed no significant relationships between order of presentation and either M.A.S. level or drug (See Appendix III a. and b.). This was true for both paired-associates learning and digit-letter coding test performance. While there were positive practice effects, these effects did not interact with either M.A.S. level or drug. Table II presents the eight orders of task presentation.

TABLE II. ORDER OF TASK PRESENTATION*

1	2	3	4	5	6	7	8
SPA	SPA	DPA	DPA	SC	SC	DC	DC
SC	DC	SC	DC	SPA	DPA	SPA	DPA
DPA	DPA	SPA	SPA	DC	DC	SC	SC
DC	SC	DC	SC	DPA	SPA	DPA	SPA

Legend - SPA = The simple paired-associates list.

DPA = The difficult paired-associates list.

SC = The simple coding test.

DC = The difficult coding test.

* = The five 2 minute pursuit rotor trials are not presented in Table

II. The first trial occurred before the first task, the second after the first task, the third after the second task, the fourth after the third task, and the fifth after the fourth task.

LEARNING AND PERFORMANCE MEASURES

Paired-Associates learning - for both lists, two measures of learning were obtained: a) trials to criterion; each subject continued to learn the paired-associates list until he correctly called out the second word of every pair on two successive presentations of the entire list; b) errors to criterion; this measure consisted of the total number of errors made by the subject in learning the list to criterion.

Digit letter coding tests - Each subject was given 4 minutes to work on each digit-letter coding test. For both tests the following measures of performance were obtained:

a) the number right

b) the number wrong.

Pursuit Rotor - the performance measure obtained for the pursuit rotor was number of seconds on target during a 120 second trial.

CHAPTER IV

RESULTS AND DISCUSSION

In view of the considerable amount of data being presented and the number of experimental questions being examined, the results relevant to a specific experimental question are presented and then immediately followed by a discussion.

The results and their discussion are divided into three sections: Section I presents the results and discussion of paired-associates learning under each of the following sub-headings:

1. The relationship between M.A.S. level and performance on the simple and difficult paired-associates lists under the no-drug condition.
2. The relationship between M.A.S. level and performance on the simple and difficult paired-associates lists under the drug condition.
3. The relationship between M.A.S. level and performance on the simple and difficult paired-associates lists under the combined drug and no-drug condition.
4. The relationship between performance on the simple and the difficult lists under drug vs. no-drug conditions without regard to M.A.S. level.
5. The relationship between performance on the simple and the difficult lists under the drug vs. the no-drug conditions within each of the M.A.S. groups considered separately.
6. The relationship between the combined effects of M.A.S. levels and drug upon the performance of the simple and the difficult test. (Drive summation).

Two measures of paired-associates learning were obtained in the present study; 1) trials to criterion, and 2) errors to criterion: Since the results for errors to criterion to a great extent parallel those obtained for the trials to criterion measure, in the interest of intelligibility only the latter measure will be examined in this section and the corresponding tables and figures for the errors measure will be placed in appendix IV.

Section II presents the results and discussion for the digit-letter coding test under each of the sub-headings employed in the above section.

Section III presents the results and discussion of pursuit-rotor learning.

SECTION 1.

The relationship between M.A.S. level and performance on the paired-associates lists. Table III shows the means and standard deviations for trials to criterion on the simple paired-associates list, the difficult paired-associates list, and the difference between the two lists. The values shown are for the 6 groups of subjects considered separately and in combination.

As was indicated in the methods chapter, the difference score is obtained by subtracting each subject's performance score on the simple list from his performance score on the difficult list. This difference score will hereafter be referred to as DS. The DS value provides simultaneously, a sensitive test of the differential prediction made by Spence and Taylor that high M.A.S. subjects are superior to low M.A.S. subjects on the simple list and low M.A.S. subjects are superior to high M.A.S. subjects on the difficult list.

1. The relationship between M.A.S. level and performance on the simple and difficult paired-associates lists under the no-drug condition.

a. Results: The top part of Figure 1 shows that for the simple paired-associates list, performance is a direct increasing function of M.A.S. level. High M.A.S. subjects required significantly fewer trials to criterion than did low M.A.S. subjects. (See table IV).

The bottom part of Figure 1 shows that for the difficult paired-associates list there is an inverse relationship between M.A.S. level and performance. Low M.A.S. subjects required significantly fewer trials to

TABLE III

Trials to Criterion for Paired-Associates Learning

CONDITION	SIMPLE LIST		DIFFICULT LIST		DIFFICULT-SIMPLE LIST	
No-Drug	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
High M.A.S.	7.06	2.11	23.56	5.56	16.50	5.04
Middle M.A.S.	8.85	2.94	21.13	4.08	12.56	4.98
Low M.A.S.	9.56	2.62	19.38	4.85	9.81	6.25
Drug						
High M.A.S.	6.56	2.13	23.31	5.16	16.75	6.69
Middle M.A.S.	7.50	2.15	21.75	3.49	14.25	4.34
Low M.A.S.	7.94	2.64	20.75	4.56	12.81	6.11
No-Drug Plus Drug						
High M.A.S.	6.81	2.14	23.44	5.36	16.63	5.93
Middle M.A.S.	8.03	2.63	21.44	3.81	13.41	4.74
Low M.A.S.	8.75	2.75	20.06	4.76	11.31	6.36
3 M.A.S. Groups Combined						
No-Drug	8.40	2.78	21.35	5.16	12.96	6.10
Drug	7.33	2.39	21.94	4.58	14.60	6.02

criterion than did high M.A.S. subjects.

For both the simple and difficult lists the mean performance of the middle M.A.S. subjects was closer to that of the low M.A.S. subjects. (See Table III and IV).

b. Discussion: The increasing direct relationship found between M.A.S. level and performance on the simple list and the inverse relationship found between M.A.S. level and performance on the difficult list (shown in Figure 1), are consistent with predictions derived from the Spence-Taylor hypothesis. To obtain a more sensitive measure of this hypothesis, each subject's performance score on the simple list was subtracted from his performance score on the difficult list to yield a Difference score DS. Figure 2 shows that for the trials to criterion measure the difference score, DS is an increasing direct function of M.A.S. level. High M.A.S. subjects had a significantly larger DS score for trials to criterion than did middle or low M.A.S. subjects.

Spence and his associates have assumed that M.A.S. level is functionally equivalent to general drive level (D) of the subject. Furthermore, they have assumed that general drive level (D) and habit strength (H) interact multiplicatively to determine performance. As was noted earlier functional relationships between M.A.S. level and performance on a variety of tasks have been found. According to Spence,

> ...the effect of variation in the level of drive upon performance in paired-associates learning depends upon the position in the habit hierarchy of the response to be learned. If the appropriate response is relatively strong in comparison with possible competing responses, it may be shown that the high A subjects should do better than low A subjects. On the other hand, if the appropriate response is initially lower in habit strength than competing responses, then the opposite findings would be expected, at least in the early stages of learning.

TABLE IV

Paired-Associates Learning for High, Middle and Low M.A.S. Subjects Under the No-Drug Condition

Trials to Criterion

CONDITION	SIMPLE LIST		DIFFICULT LIST		DIFFICULT-SIMPLE LIST	
No-Drug	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
High M.A.S.	7.06	2.11	23.56	5.56	16.50	5.04
Middle M.A.S.	8.85	2.94	21.13	4.08	12.56	4.98
Low M.A.S.	9.56	2.62	19.38	4.85	9.81	6.25

SIMPLE PAIRED-ASSOCIATES LIST

	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	2.50	2.87	.01
High M.A.S. vs. Middle M.A.S.	1.50	1.61	n.s.
Middle M.A.S. vs. Low M.A.S.	1.00	.98	n.s.

DIFFICULT PAIRED-ASSOCIATES LIST

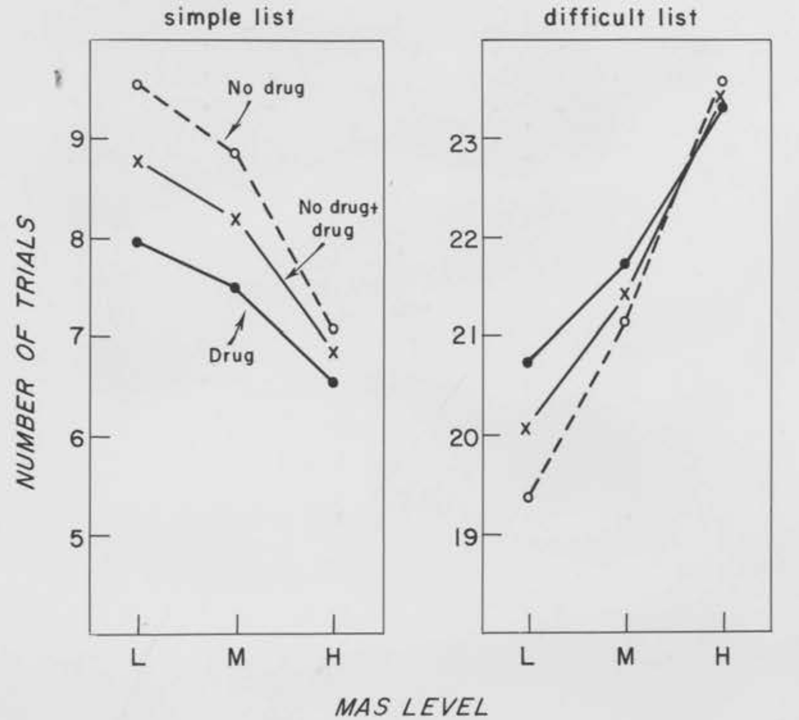
	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	4.18	2.20	.05
High M.A.S. vs. Middle M.A.S.	2.43	1.37	n.s.
Middle M.A.S. vs. Low M.A.S.	1.75	1.07	n.s.

DIFFICULT-SIMPLE PAIRED-ASSOCIATES LISTS

	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	6.69	3.23	.01
High M.A.S. vs. Middle M.A.S.	3.94	2.15	.05
Middle M.A.S. vs. Low M.A.S.	2.75	1.33	n.s.

Figure 1

PAIRED-ASSOCIATES LEARNING—TRIALS TO CRITERION



The results of the present study, i.e., that high M.A.S. subjects are significantly superior to low M.A.S. subjects on the simple list, and low M.A.S. subjects are significantly superior to high M.A.S. subjects on the difficult list are in accord with the results obtained in earlier studies. The present study moreover, goes further in extending the generality of previous findings since it employed a more critical test of this relationship. Specifically, previous studies have employed exclusively independent samples of high and low M.A.S. subjects and studied their performance on a single task, i.e., either a simple or difficult list. In contrast, in the present study each subject performed on both the simple and the difficult lists. This procedure was employed to provide a more sensitive measure of the differential prediction that 1) high M.A.S. subjects are superior to low M.A.S. subjects on the simple list and 2) that low M.A.S. subjects are superior to high M.A.S. subjects on the difficult list. With this measure it would be predicted that high M.A.S. subjects would have a significantly larger difference score, DS value than low M.A.S. subjects. This prediction was confirmed.

2. The relationship between M.A.S. level and performance on the simple and difficult paired-associates lists under the drug condition.

a. Results: As may be seen in Figure 1 there is an increasing direct relationship between M.A.S. level and performance on the simple list and an inverse relationship between M.A.S. level and performance on the difficult list. In contrast with the no-drug condition, the differences between high and low M.A.S. subjects, while in the same direction, are in no case significant under the drug condition. This was true for both the simple and the difficult lists. (See Table V).

Furthermore, in table V we observe that the difference score analysis does not yield any significant differences although high M.A.S. subjects had a larger DS value than did low M.A.S. subjects. (See Figure 2 and table V). The empirical relationships between M.A.S. level and performance under the drug condition tended to parallel those found under the no-drug condition but the differences between high and low M.A.S. subjects were not significant.

A fuller discussion of the implications of these findings will be examined later in connection with the discussion of the effects of drug and M.A.S. level upon summation.

3. The relationship between M.A.S. level and performance on the simple and difficult paired-associates lists under the combined drug and no-drug conditions.

a. Results: It was noted earlier that while the differences between M.A.S. levels under the drug condition were not significant they were in the same direction as those obtained under the no-drug condition. Table VI and Figure 1 show that when the drug and the no-drug conditions are combined performance on the simple list is an increasing direct function of M.A.S. level, while for the difficult list performance is inversely related to M.A.S. level. That is, high M.A.S. subjects required significantly fewer trials to criterion than did middle or low M.A.S. subjects. On the difficult list low M.A.S. subjects required significantly fewer trials to criterion than did high M.A.S. subjects.

In the same table and in Figure 2 a direct relationship between M.A.S. level and the DS measure for trials to criterion is presented. High M.A.S. subjects had a significantly larger DS score for trials to

TABLE V

Paired-Associates Learning for High, Middle and Low M.A.S. Subjects Under the Drug Condition

Trials to Criterion

CONDITION	SIMPLE LIST		DIFFICULT LIST		DIFFICULT-SIMPLE LIST	
Drug	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
High M.A.S.	6.56	2.13	23.31	5.16	16.75	6.69
Middle M.A.S.	7.50	2.15	21.75	3.49	14.25	4.34
Low M.A.S.	7.94	2.64	20.75	4.56	12.81	6.11

SIMPLE PAIRED-ASSOCIATES LIST

	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	1.38	1.59	n.s.
High M.A.S. vs. Middle M.A.S.	.94	1.21	n.s.
Middle M.A.S. vs. Low M.A.S.	.44	.50	n.s.

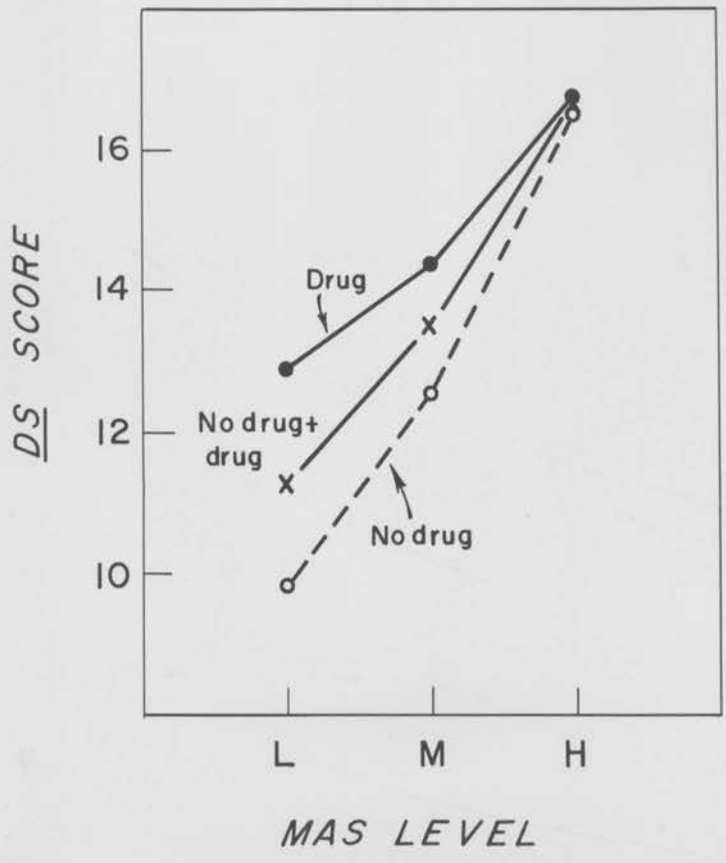
DIFFICULT PAIRED-ASSOCIATES LIST

	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	2.56	1.44	n.s.
High M.A.S. vs. Middle M.A.S.	1.56	.97	n.s.
Middle M.A.S. vs. Low M.A.S.	1.00	.67	n.s.

DIFFICULT-SIMPLE PAIRED-ASSOCIATES LISTS

	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	3.94	1.68	n.s.
High M.A.S. vs. Middle M.A.S.	2.50	1.21	n.s.
Middle M.A.S. vs. Low M.A.S.	1.44	.74	n.s.

Figure 2
PAIRED-ASSOCIATES LEARNING
TRIALS TO CRITERION



criterion than did middle or low M.A.S. subjects.

b. Discussion: The results for the combined drug and no-drug conditions demonstrate the same significant differences that were found between high and low M.A.S. subjects under the no-drug condition. The present study, in addition to using a correlated sample on the simple and the difficult lists, also differed from many earlier studies in that a middle M.A.S. group was employed. Middle M.A.S. subjects were included in the study for two reasons: first, with the use of a correlated sample it was felt that the liklihood of obtaining more useful information about the over-all score range and performance would be possible and second, it was desirable to assess the effects of the drug upon a group that was neither high nor low on the test continum.

Under the drug and under the no-drug condition the performance of middle M.A.S. subjects fell closer to the performance of low M.A.S. subjects than to the performance of high M.A.S. subjects. This held true for both the simple and the difficult lists. There were some significant differences between the performance of high and middle M.A.S. subjects. (See table IV and VI). The results of the present study are in agreement with the few studies employing a middle drive group. Montague, 1953, reported data which suggested that the Taylor Manifest Anxiety Scale might discriminate only extremely high M.A.S. subjects from the rest of the distribution of M.A.S. scores. Sarason, 1956, failed to obtain differences in performance on a serial verbal learning task between middle and low M.A.S. subjects. The results of the present study, together with the findings obtained by Montague and Sarason, all in verbal learning situations, support the assumption that the Taylor scale as it stands can dis-

TABLE VI

Paired-Associates Learning for High, Middle and Low M.A.S. Subjects Under the Combined No-Drug and Drug Conditions

Trials to Criterion

CONDITION	SIMPLE LIST		DIFFICULT LIST		DIFFICULT-SIMPLE LIST	
No-Drug Plus Drug	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
High M.A.S.	6.81	2.14	23.44	5.36	16.63	5.93
Middle M.A.S.	8.03	2.63	21.44	3.81	13.41	4.74
Low M.A.S.	8.75	2.75	20.06	4.76	11.31	6.36

SIMPLE PAIRED-ASSOCIATES LIST

	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	1.96	3.13	.01
High M.A.S. vs. Middle M.A.S.	1.22	2.01	.05
Middle M.A.S. vs. Low M.A.S.	.72	1.06	n.s.

DIFFICULT PAIRED-ASSOCIATES LIST

	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	3.38	2.62	.02
High M.A.S. vs. Middle M.A.S.	2.00	1.69	.10
Middle M.A.S. vs. Low M.A.S.	1.38	1.25	n.s.

DIFFICULT-SIMPLE PAIRED-ASSOCIATES LISTS

	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	5.32	3.41	.01
High M.A.S. vs. Middle M.A.S.	3.22	2.44	.02
Middle M.A.S. vs. Low M.A.S.	2.10	1.47	n.s.

tinguish only the highest scores from the rest of the scores in the distribution. In other words, these results imply that the Taylor scale may simply dichotomize subjects rather than order them.

The results of the present study gave, however, no indication that the reaction of middle M.A.S. subjects to the drug was in any way different from the reaction of high or low M.A.S. subjects to the drug.

4. The relationship between performance on the simple and the difficult lists under drug vs. no-drug conditions without regard to M.A.S. level.

a. Results: The bottom line of table VII shows the effects of the drug as compared with that of no-drug on the performance of all three M.A.S. groups combined, on both the simple and the difficult paired-associates lists. On the simple list subjects under the drug condition required significantly fewer trials to criterion than did no-drug subjects. Subjects under the drug condition did somewhat poorer on the difficult list than did no-drug subjects but this difference was not significant.

b. Discussion: The findings of the present study suggest that the effects of the drug upon the performance of the simple or non-competitive paired-associates list are similar to the effects produced by high M.A.S. level, i.e., both drug and high M.A.S. level significantly facilitate performance on the simple paired-associates list. However, on the difficult list there was no statistically significant difference between the performances of subjects under the drug and no-drug conditions.

The results of the present study are in agreement with those of earlier studies of the effects of amphetamine upon the learning and performance of various behavioral tasks; (See Franks, 1958, Willet, 1957, Barmark, 1938, Kleemier and Kleemier, 1947, and Eysenck, 1957). These

TABLE VII

Paired-Associates Learning for High, Middle and Low M.A.S. Subjects, and for the Three Groups Combined Under Drug vs. No-Drug Conditions

Trials to Criterion

CONDITION	SIMPLE LIST		DIFFICULT LIST		DIFFICULT-SIMPLE LIST	
No-Drug	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
High M.A.S.	7.06	2.11	23.56	5.56	16.50	5.04
Middle M.A.S.	8.85	2.94	21.13	4.08	12.56	4.98
Low M.A.S.	9.56	2.62	19.38	4.85	9.81	6.25
Drug						
High M.A.S.	6.56	2.13	23.31	5.16	16.75	6.69
Middle M.A.S.	7.50	2.15	21.75	3.49	14.25	4.34
Low M.A.S.	7.94	2.64	20.75	4.56	12.81	6.11
3 M.A.S. Groups Combined						
No-Drug	8.40	2.78	21.35	5.16	12.96	6.10
Drug	7.33	2.39	21.94	4.58	14.60	6.02

	SIMPLE LIST			DIFFICULT LIST		
	M.D.	t	p Value	M.D.	t	P Value
High M.A.S.	+.50	.64	n.s.	+.25	.13	n.s.
Middle M.A.S.	+1.06	1.13	n.s.	+.62	.45	n.s.
Low M.A.S.	+1.62	1.69	.10	-1.37	.80	n.s.
3 M.A.S. Groups Combined	+1.07	1.97	.05	-.59	.61	n.s.

+ = drug facilitates
\- = drug impairs

studies have consistently demonstrated that while amphetamine facilitates the performance of simple tasks it has little or no effect upon the performance of difficult or competitive tasks.

5. The relationship between performance on the simple and the difficult lists under the drug vs. the no-drug conditions within each of the M.A.S. groups considered separately.

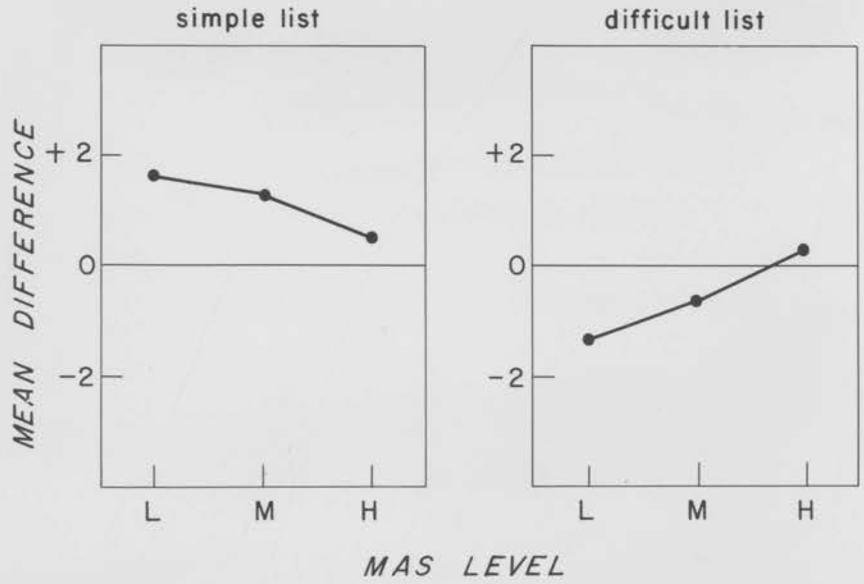
a. Results: Figure 3 shows the drug effect upon performance for the three M.A.S. groups. On the simple paired-associates list the extent of amphetamine facilitation is inversely related to M.A.S. level, i.e., low M.A.S. subjects received more facilitation from the drug than did high M.A.S. subjects. On the difficult list the extent of amphetamine facilitation was directly related to M.A.S. level, i.e., low M.A.S. subjects showed no facilitation under amphetamine while high M.A.S. subjects showed some facilitation from the drug. As shown in table VII there were no significant differences between the drug and the no-drug subjects within each of the three M.A.S. groups considered separately.

Figure 3

PAIRED-ASSOCIATES LEARNING - DRUG vs NO DRUG

TRIALS TO CRITERION

+ = drug facilitates, − = drug impairs



DRIVE SUMMATION

Drive within the Hullian framework has been conceptualized as an energizing factor. As formalized by Hull, 1943, when drive level is zero there is no evocation of behavior, and the greater the drive strength the stronger the performance as measured by its persistance and its speed. In addition Hull assumed that all types of drive have comparable effects on performance measures.

Acceptance of the Hullian conception of drive logically implies that: a) two drive states should have a summative effect on performance. The results of several studies lend support to this assumption. Hall, 1956, found that the addition of relatively intense buzzers to the rat's environment produced an increase in wheel-turning activity, and that this activity was even further augmented by food deprivation. Levine et. al., 1959, combined two aversive drives, emotionality and escape from water, and found that the two drives did summate, i.e., animals receiving shock prior to being tested on the water maze showed significantly faster swimming times than their non-shocked counter-parts. Segal, 1959, found that under conditions of light reinforcement food-deprived animals reached a higher operant level than their satiated counter-parts. Clayton, 1958, found that light acted as a reinforcing stimulus and that deprived animals made more bar responses than non-deprived animals under both light absent and light present conditions.

b) A second implication of Hull's multiplicative drive theory is that an increase in drive can either facilitate or hinder performance during learning, depending upon which response in the organism's hierarchy has the greatest habit strength. If the "correct" response is first in the hierarchy, high D should facilitate performance, but if an incorrect one is first, high D should hinder the acquisition of the correct behavior. Methods of controlling the relative strengths of correct and incorrect response tendencies as well as supporting evidence for the differential prediction concerning the relationship between drive level and performance have already been discussed in earlier sections. The present study was concerned with the relationship between two drive states and performance on certain behavioral tasks. The study was designed in such a way as to provide a test of drive summation in human subjects. Drive summation will be examined under four paradigms and the results of the present study will be discussed in connection with the theoretical assumptions above and previous empirical findings.

6. Drive Summation: The relationship between the combined effects of M.A.S. and drug upon the performance of the simple and the difficult paired-associates list.

Paradigm 1: If high M.A.S. level, D1, as compared to low M.A.S. level leads to effect A and effect A is superior performance on the non-competitive paired-associates list, then high M.A.S. level, D1, plus drug, D2, should lead to greater superiority in performance than that produced by D1 alone. That is, performance as a function of D1 + D2 should be superior to performance as a function of D1 alone, on the non-competitive list.

Paradigm 2: If high M.A.S. level, D1, as compared to low M.A.S. level leads to effect B and effect B is inferior performance on the difficult or competitive paired-associates list, then high M.A.S. level, D1, plus drug, D2, should lead to even poorer performance than that produced by D1 alone. That is, performance as a function of D1 + D2 should be inferior to performance as a function of D1 alone on the competitive list.

a. Results: The results for the first paradigm were in the predicted direction, i.e., high M.A.S. subjects in the drug group, D1 + D2, required fewer trials to criterion on the non-competitive paired-associates list than did high M.A.S. subjects in the no-drug group. (See table III). This difference, however, (.50) was small and non-significant. (See table VII and Figure 3).

The results for the second paradigm were not in the predicted direction, i.e., high M.A.S. subjects under the drug condition D1 + D2, did slightly better on the difficult or competitive paired-associates list than did their no-drug counterparts. (See table III and VII). Again, however, this difference (.25) was small and non-significant.

Thus, in the present study the combination of high M.A.S. level, D1, and drug, D2, as compared with D1 alone, lead to only slightly superior performance on the non-competitive paired-associates list and did not lead to inferior performance as predicted on the competitive list. In both cases the differences were small and can best be attributed to chance variation.

b. Discussion: The possibility that high M.A.S subjects are already working under maximum drive conditions and the addition of another drive, (drug), contributed little to their performance on the two paired-associates lists may explain the negative findings with regard to drive summation in the first two paradigms.* Still another possibility may be the measure of drive employed in the present study, i.e., had the number of adjective pairs in each list been increased the effect of the drug, D2, upon the performance of high M.A.S., D1, subjects might have been more striking. Whatever the basis for the present findings the conclusion remains that the addition of D2 to D1 in the present situation did not lead to the performance predicted by the two drive summation paridigms.

Examination of Drive Summation in low M.A.S. Subjects

Paradigm 3: If low M.A.S. level D3 as compared with high M.A.S. level leads to effect C and effect C is inferior performance on the non-competitive paired-associates list then low M.A.S. level plus drug D4 should lead to greater superiority in performance on the non-competitive list than that produced by D3 alone. That is, performance as a function of D3 + D4 will be superior to performance as a function of D3 alone on the non-competitive list.

Paradigm 4: If low M.A.S. level D3 as compared with high M.A.S. level leads to effect D and effect D is superior performance on the competitive paired-associates list, then low M.A.S. level, D3, plus drug, D4, should lead to poorer performance on the competitive list than that produced by D3 alone. That is, performance as a function of D3 + D4 will be inferior to performance as a function of D3 alone on the competitive list.

a. Results: The findings for paradigm 3 are in the predicted direction, i.e., low M.A.S. subjects under the drug condition, D3 + D4,

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*This explanation has indeed been previously suggested, e.g., Amsel, 1950, and will be more fully discussed in Section II.

require fewer trials to criterion than did low M.A.S. subjects under the no-drug condition. (See table III). The difference between these two groups (1.62), gave a t value of 1.69, p=.10. (See table VII).

The results for paradigm 4 were also in the predicted direction, i.e., low M.A.S. subjects under the drug condition, D3 + D4, required more trials to criterion than their no-drug counter-parts on the competitive paired-associates list. (See table III). This difference, (1.37), however was not significant. (See table VII).

b. Discussion: Four predictive paradigms of drive summation were examined. While certain tendencies toward drive summation were noted in all, none was significant. The tendencies for drive summation were most clearly observed in the performance of low M.A.S. subjects under the drug condition. As may be seen in Figure 3, low M.A.S. subjects showed the greatest facilitation in performance by the drug, i.e., the drug greatly facilitated their performance on the non-competitive paired-associates list. The drug also had the greatest effect on the performance of the competitive list by this group, i.e., their performance on the competitive list was greatest in the drug condition. A possible explanation for the lack of effect of the drug on high M.A.S. subjects was proposed, namely, that high M.A.S. subjects were already at maximum drive.

SECTION 2

The relationship between M.A.S. level and performance on the digit-letter coding test.

Table VIII shows the means and standard deviations for number right on the simple digit letter coding test, the difficult digit letter coding test, and the difference between the two tests. The values shown are for the 6 groups of subjects considered separately and in combination.*

The difference score was obtained by subtracting each subject's performance score on the difficult test from his performance score on the simple test.

Table IX presents corresponding data for the number right minus the number wrong on the simple digit-letter coding test, the difficult digit-letter coding test and the difference between the two tests.**

In the interests of intelligibility and clarity data relevant to number wrong only are presented in appendix V.

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* The number right on the simple coding test will hereafter be referred to as Sr. The number right on the difficult test will hereafter be referred to as Dr. The number right on the simple test minus the number right on the difficult test will hereafter be referred to as Sr-Dr.

** The number right minus the number wrong on the simple test will hereafter be referred to as Sr-Sw.

The number right minus the number wrong on the difficult test will hereafter be referred to as Dr-Dw.

The difference score or the number right minus the number wrong on the simple test minus the number right minus the number wrong on the difficult test will hereafter be referred to as (Sr-Sw)-(Dr-Dw).

TABLE VIII

Digit Letter Coding Test Performance

Number Right

CONDITION	SIMPLE CODING		DIFFICULT CODING		SIMPLE-DIFFICULT	
No-Drug	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
High M.A.S.	46.06	4.49	22.75	7.38	23.94	7.74
Middle M.A.S.	44.50	9.03	24.38	9.07	20.13	9.16
Low M.A.S.	42.81	8.50	23.13	8.95	19.69	11.52
Drug						
High M.A.S.	49.13	9.65	22.56	8.19	26.56	11.39
Middle M.A.S.	50.06	7.50	23.75	9.29	26.25	8.65
Low M.A.S.	47.63	6.78	25.00	7.20	22.63	7.93
No-Drug Plus Drug						
High M.A.S.	47.59	7.68	22.68	7.79	25.25	9.83
Middle M.A.S.	47.28	8.69	24.06	9.18	23.19	9.42
Low M.A.S.	45.22	8.06	24.06	8.18	21.16	10.00
3 M.A.S. Groups Combined						
No-Drug	44.46	7.73	23.42	8.53	21.25	9.79
Drug	48.94	8.13	23.77	8.33	25.15	9.67

TABLE IX

Digit Letter Coding Test Performance

Number Right-Number Wrong

CONDITION	(Sr-Sw)		(Dr-Dw)		(Sr-Sw)-(Dr-Dw)	
No-Drug	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
High M.A.S.	43.31	4.92	17.00	9.34	26.31	6.50
Middle M.A.S.	40.31	10.32	18.56	8.35	21.81	11.96
Low M.A.S.	38.38	7.43	18.44	11.74	19.94	12.62
Drug						
High M.A.S.	45.00	11.00	16.88	9.65	28.13	14.82
Middle M.A.S.	46.38	8.83	18.13	11.38	28.25	11.88
Low M.A.S.	44.56	7.43	21.56	8.38	23.00	8.43
No-Drug Plus Drug						
High M.A.S.	44.16	8.56	16.94	9.50	27.22	11.48
Middle M.A.S.	43.34	10.07	18.34	9.98	25.03	12.35
Low M.A.S.	41.47	9.43	20.00	10.47	21.47	10.84
3 M.A.S. Groups Combined						
No-Drug	40.67	9.07	18.00	9.94	22.69	11.05
Drug	45.31	9.23	18.85	10.08	26.46	12.25

1. The relationship between M.A.S. level and performance on the digit letter coding tests under the no-drug condition.

Figure 4 and figure 4a show that performance on the simple coding test, for both Sr and Sr-Sw measures is an increasing direct function of M.A.S. level. Performance on the difficult test is not related to M.A.S. level as measured by Dr (See figure 4), but with the Dr-Dw measure performance on the difficult test is shown to be an inverse function of M.A.S. level (See Figure 4a).

Tables VIII and IX reveal that high M.A.S. subjects had a higher score than middle or low M.A.S. subjects on the simple test for both Sr and Sr-Sw measures. Low and middle M.A.S. subjects had a higher score than high M.A.S. subjects for both Dr and Dr-Dw measures. High M.A.S. subjects also had a larger Sr-Dr and (Sr-Sw)-(Dr-Dw) values than middle or low M.A.S. subjects.

In no case were the performance differences of the three M.A.S. groups cited above significant (See Table X).

b. Discussion:

The Sr-Sw and Dr-Dw measures seemed to be a more sensitive measure of the differences between high and low M.A.S. subjects, i.e., this measure gave larger t values. (See Table X). The fact that there is little or no difference in the performance of high and low M.A.S. subjects as measured by Dr and that low M.A.S. subjects are superior to high M.A.S. subjects as measured by Dr-Dw, implies that high M.A.S. subjects get as many rights as low M.A.S. subjects on the difficult test by virtue of their working faster.

The present study found tendencies which suggest that high M.A.S.

Figure 4

DIGIT LETTER CODING TESTS

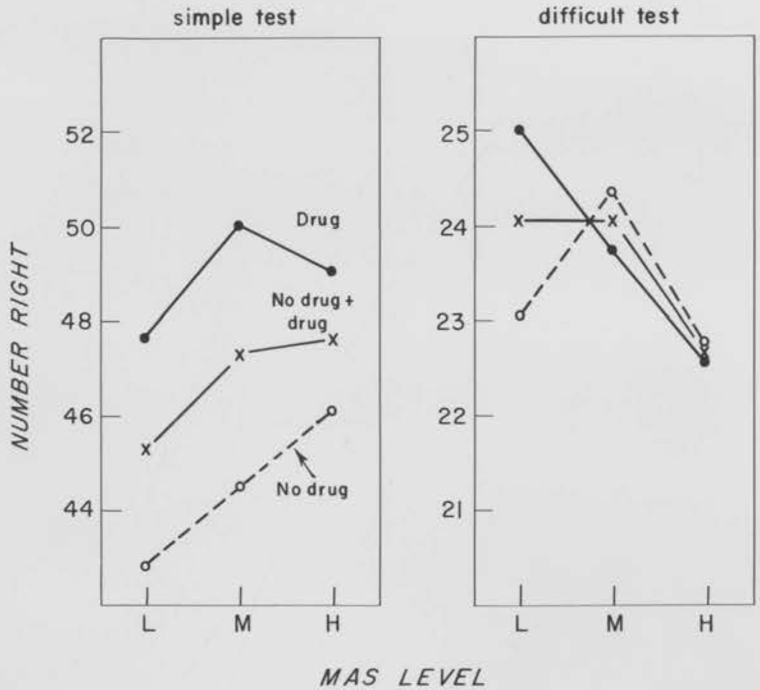


Figure 4a

DIGIT LETTER CODING TESTS

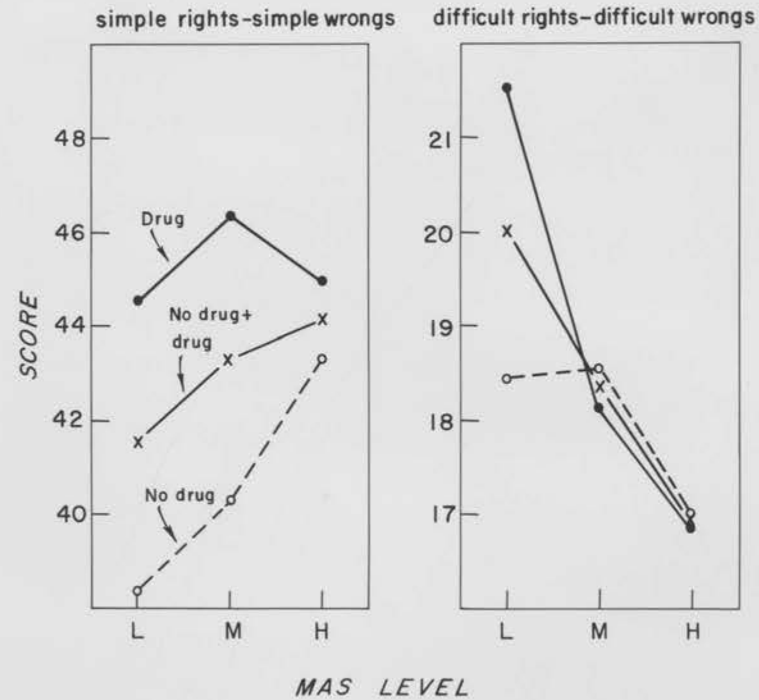


TABLE X

Digit Letter Coding Test Performance for High, Middle and Low M.A.S. Subjects Under the No-Drug Condition

	SIMPLE CODING RIGHTS			(Sr-Sw)		
CONDITION	M.D.	t	p Value	M.D.	t	p Value
High M.A.S. vs. Low M.A.S.	3.25	1.31	n.s.	4.93	1.69	.10
High M.A.S. vs. Middle M.A.S.	1.56	.60	n.s.	3.00	1.01	n.s.
Middle M.A.S. vs. Low M.A.S.	1.69	.53	n.s.	1.93	.51	n.s.
	DIFFICULT CODING RIGHTS			(Dr-Dw)		
	M.D.	t	p Value	M.D.	t	p Value
High M.A.S. vs. Low M.A.S.	.38	.13	n.s.	1.44	.37	n.s.
High M.A.S. vs. Middle M.A.S.	1.63	.54	n.s.	1.56	.48	n.s.
Middle M.A.S. vs. Low M.A.S.	1.25	.38	n.s.	.12	.03	n.s.
	SIMPLE RIGHTS-DIFFICULT RIGHTS			(Sr-Sw)-(Dr-Dw)		
	M.D.	t	p Value	M.D.	t	p Value
High M.A.S. vs. Low M.A.S.	4.25	1.18	n.s.	6.37	1.74	.10
High M.A.S. vs. Middle M.A.S.	3.81	1.23	n.s.	4.50	1.28	n.s.
Middle M.A.S. vs. Low M.A.S.	.44	.12	n.s.	1.87	.42	n.s.

subjects were superior to middle and low M.A.S. subjects on the simple test, and low M.A.S. subjects were superior to high M.A.S. subjects on the difficult test. In no instance were any of the above differences significant. Of considerable interest, however, is the fact that for almost all performance measures, middle M.A.S. subjects fell closer to the scores of low M.A.S. subjects than to the scores of high M.A.S. subjects. The similarity of this last finding to those in paired associates and implications were discussed more extensively in Section 1.

The results of this study suggest that M.A.S. level does not influence performance on the digit letter coding tests in the manner found for paired-associates learning.

2. <u>The relationship between M.A.S. level and performance on the digit letter coding tests under the drug condition</u>.

a. <u>Results</u>:

Figure 4 and Figure 4a show that performance (excluding middle M.A.S. subjects) on the simple test is a direct function of M.A.S. level while performance on the difficult list is an inverse function of M.A.S. level as measured in terms of both number right, Sr, Dr and the number right minus number wrong, Sr-Sw, and Dr-Dw.

While high M.A.S. subjects had more 'rights' than low M.A.S. subjects on the simple test and low M.A.S. subjects had more 'rights' than high M.A.S. subjects, although these differences were in no case significant. (See Table XI).

Furthermore, as may be seen in Table XI, although high M.A.S. subjects had a larger difference score than middle or low M.A.S. subjects these differences were not significant.

TABLE XI

Digit Letter Coding Test Performance for High, Middle and Low M.A.S. Subjects Under the Drug Condition

CONDITION	SIMPLE CODING RIGHTS			(Sr-Sw)		
	M.D.	t	p Value	M.D.	t	p Value
High M.A.S. vs. Low M.A.S.	1.50	.49	n.s.	.44	.13	n.s.
High M.A.S. vs. Middle M.A.S.	.93	.29	n.s.	1.38	.38	n.s.
Middle M.A.S. vs. Low M.A.S.	2.43	.93	n.s.	1.82	.61	n.s.
	DIFFICULT CODING RIGHTS			(Dr-Dw)		
	M.D.	t	p Value	M.D.	t	p Value
High M.A.S. vs. Low M.A.S.	2.44	.87	n.s.	4.68	1.41	n.s.
High M.A.S. vs. Middle M.A.S.	1.19	.37	n.s.	1.25	.32	n.s.
Middle M.A.S. vs. Low M.A.S.	1.25	.41	n.s.	3.43	.94	n.s.
	SIMPLE RIGHTS-DIFFICULT RIGHTS			(Sr-Sw)-(Dr-Dw)		
	M.D.	t	p Value	M.D.	t	p Value
High M.A.S. vs. Low M.A.S.	3.93	1.09	n.s.	5.13	1.16	n.s.
High M.A.S. vs. Middle M.A.S.	.31	.08	n.s.	.12	.02	n.s.
Middle M.A.S. vs. Low M.A.S.	3.62	1.19	n.s.	5.25	1.39	n.s.

b. Discussion:

The present study found relationships between M.A.S. level and performance under the drug condition which tended to parrallel those found under the no-drug condition. As was found in the no-drug condition the differences between high and low M.A.S. subjects were not significant. While high M.A.S. subjects had larger difference scores than middle or low M.A.S. subjects these differences were in no instance significant. (See Table XI).

The findings of the present study suggest that the major effects of drug action are to produce 1) a reduction of differences in performance of M.A.S. groups on the simple test and 2) an increase in the performance differences of high and low M.A.S. subjects on the difficult test. The differential effect of drug upon the performance of the three M.A.S. levels will be discussed more fully under drive summation and under performance as a function of drug vs. no-drug conditions within each of the M.A.S. groups considered separately.

3. The relationship between M.A.S. level and performance on the digit letter coding tests under the combined drug and no-drug conditions.

a. Results:

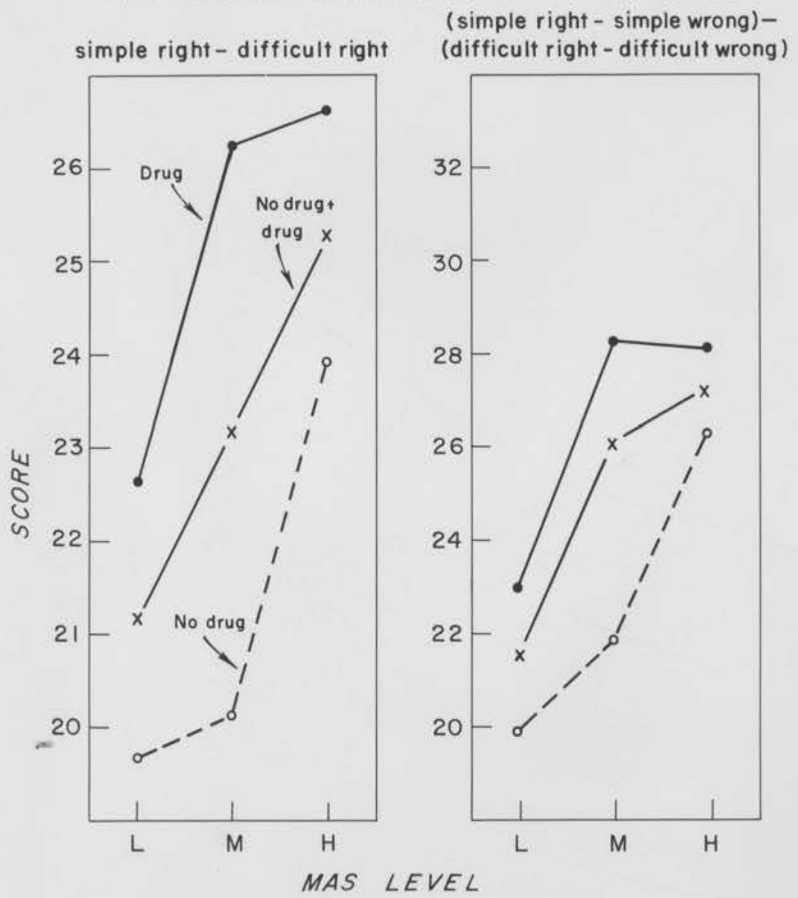
It was noted that while the differences between M.A.S. levels under the no-drug and under the drug condition were not significant they were in the same direction.

Figure 4 and Figure 4a show that performance on the simple test is an increasing direct function of M.A.S. level and performance on the difficult test is an inverse function of M.A.S. level.

While high M.A.S. subjects are superior to middle and low M.A.S.

Figure 5

DIGIT LETTER CODING TESTS - DS VALUE



subjects and low and middle M.A.S. subjects are superior to high M.A.S. subjects none of the above differences were significant. (See table XII).

High M.A.S. subjects had a significantly larger difference score than low M.A.S. subjects as measured by (Sr-Sw)-(Dr-Dw). See table XII. This last finding was the only significant measure of performance differences between high and low M.A.S. subjects.

b. Discussion:

The present study found tendencies for high M.A.S. subjects to be superior to low M.A.S. subjects on the simple test and for low M.A.S. subjects to be superior to high M.A.S. subjects on the difficult test. These tendencies were evident both for the drug and no-drug conditions. When drug and no-drug conditions were combined only one significant difference between the performance of high and low M.A.S. subjects emerged. This difference as noted above was for a derived score which employed rights and wrongs on both the simple and the difficult tests.

4. The relationship between performance on the simple and difficult digit-letter coding tests under drug vs. no-drug conditions without regard to M.A.S. level.

a. Results:

The bottom line of tables XIII and XIV show the effects of the drug as compared with that of no-drug on the performance of all three M.A.S. groups combined, on the simple and the difficult digit-letter coding tests. On the simple test subjects under the drug condition had significantly higher scores as measured by both Sr and Sr-Sw, than did their no-drug counterparts. Subjects under the drug condition also did somewhat

TABLE XII

Digit Letter Coding Test Performance for High, Middle and Low M.A.S. Subjects Under the Combined Drug and No-Drug Conditions

CONDITION	SIMPLE CODING RIGHTS			(Sr-Sw)		
	M.D.	t	p Value	M.D.	t	p Value
High M.A.S. vs. Low M.A.S.	.31	.15	n.s.	2.69	1.17	n.s.
High M.A.S. vs. Middle M.A.S.	2.06	.96	n.s.	.82	.34	n.s.
Middle M.A.S. vs. Low M.A.S.	2.37	1.19	n.s.	1.87	.75	n.s.
	DIFFICULT CODING RIGHTS			(Dr-Dw)		
	M.D.	t	p Value	M.D.	t	p Value
High M.A.S. vs. Low M.A.S.	1.40	.65	n.s.	3.06	1.20	n.s.
High M.A.S. vs. Middle M.A.S.	--	--	--	1.40	.56	n.s.
Middle M.A.S. vs. Low M.A.S.	1.40	.69	n.s.	1.66	.64	n.s.
	SIMPLE RIGHTS-DIFFICULT RIGHTS			(Sr-Sw)-(Dr-Dw)		
	M.D.	t	p Value	M.D.	t	p Value
High M.A.S. vs. Low M.A.S.	4.09	1.62	n.s.	5.75	2.02	.05
High M.A.S. vs. Middle M.A.S.	2.06	.84	n.s.	2.19	.72	n.s.
Middle M.A.S. vs. Low M.A.S.	2.03	.83	n.s.	3.56	1.21	n.s.

better on the difficult digit letter coding test than did no-drug subjects but this difference was not significant.

b. Discussion:

The results of the present study are in agreement with the findings reported in the previous studies on the effects of amphetamine upon performance. The literature consistently reports that amphetamine significantly facilitates the performance of relatively simple motor and intellectual behaviors. (Kleemier and Kleemier, 1947, Barmark, 1938, Payne and Hauty, 1953, Smith, Weitzner and Beecher, 1963, etc.). Furthermore, the results of a number of other studies suggest that amphetamine has little or no facilitating effect upon the performance of high level intellectual tasks and difficult or competitive verbal and motor behaviors. Andrews, 1940, Willet, 1958, Smith, Weitzner, and Beecher, 1963, etc.

5. The relationship between performance on the simple and difficult digit-letter coding tests under the drug vs. the no-drug conditions within each of the three M.A.S. groups considered separately.

a. Results:

Figure 6 and Figure 6a show the relationship of the drug to performance for the three M.A.S. groups. On the simple and on the difficult digit-letter coding tests the extent of amphetamine facilitation is inversely related to M.A.S. level, i.e., low M.A.S. subjects received more facilitation from the drug than did high M.A.S. subjects. As may be seen in tables XIII and XIV there were no significant differences between the drug and the no-drug subjects within each of the three M.A.S. groups considered separately.

TABLE XIII

Digit Letter Coding Test Performance for High, Middle and Low M.A.S. Subjects and for the Three Groups Combined Under Drug vs. No-Drug Conditions

Number Right

CONDITION	SIMPLE CODING		DIFFICULT CODING		SIMPLE-DIFFICULT	
No-Drug	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
High M.A.S.	46.06	4.49	22.75	7.38	23.94	7.74
Middle M.A.S.	44.50	9.03	24.38	9.07	20.13	9.16
Low M.A.S.	42.81	8.50	23.13	8.95	19.69	11.52
Drug						
High M.A.S.	49.13	9.65	22.56	8.19	26.56	11.39
Middle M.A.S.	50.06	7.50	23.75	9.29	26.25	8.65
Low M.A.S.	47.63	6.78	25.00	7.20	22.63	7.93
3 M.A.S. Groups Combined						
No-Drug	44.46	7.73	23.42	8.53	21.25	9.79
Drug	48.94	8.13	23.77	8.33	25.15	9.67

	SIMPLE RIGHTS			DIFFICULT RIGHTS			(Sr-Dr)		
	M.D.	t	p Value	M.D.	t	p Value	M.D.	t	p Value
H.A.S. vs. H.A.P.	+3.07	1.12	n.s.	- .19	.07	n.s.	2.62	.74	n.s.
M.A.S. vs. M.A.P.	+5.56	1.83	.10	- .63	.19	n.s.	6.12	1.88	.10
L.A.S. vs. L.A.P.	+4.82	1.71	.10	+1.87	.63	n.s.	2.94	.81	n.s.
Drug vs. No-Drug	+4.48	2.81	.01	+ .35	.22	n.s.	3.90	1.97	.05

+ = drug facilitates
- = drug impairs

TABLE XIV

Digit Letter Coding Test Performance for High, Middle and Low M.A.S. Subjects and for the Three Groups Combined Under Drug vs. No-Drug Conditions

Number Right-Number Wrong

CONDITION	(Sr-Sw)		(Dr-Dw)		(Sr-Sw)-(Dr-Dw)	
	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
No-Drug						
High M.A.S.	43.31	4.92	17.00	9.34	26.31	6.50
Middle M.A.S.	40.31	10.32	18.56	8.35	21.81	11.96
Low M.A.S.	38.38	7.43	18.44	11.74	19.94	12.62
Drug						
High M.A.S.	45.00	11.00	16.88	9.65	28.13	14.82
Middle M.A.S.	46.38	8.83	18.13	11.38	28.25	11.88
Low M.A.S.	44.56	7.43	21.56	8.38	23.00	8.43
3 M.A.S. Groups Combined						
No-Drug	40.67	9.07	18.00	9.94	22.69	11.05
Drug	45.31	9.23	18.85	10.08	26.46	12.25

	Sr-Sw			Dr-Dw			(Sr-Sw)-(Dr-Dw)		
	M.D.	t	p Value	M.D.	t	p Value	M.D.	t	p Value
H.A.S. vs. H.A.P.	+1.69	.54	n.s.	- .12	.03	n.s.	+1.82	.44	n.s.
M.A.S. vs. M.A.P.	+6.07	1.73	.10	- .43	.12	n.s.	+6.44	1.48	n.s.
L.A.S. vs. L.A.P.	+6.18	1.90	.10	+3.12	.84	n.s.	+3.06	.78	n.s.
Drug vs. No-Drug	+4.64	2.46	.02	+ .85	.41	n.s.	+3.77	1.56	n.s.

\+ = drug facilitates
\- = drug impairs

Figure 6

DIGIT LETTER CODING TESTS – DRUG vs NO DRUG

+ = drug facilitates, – = drug impairs

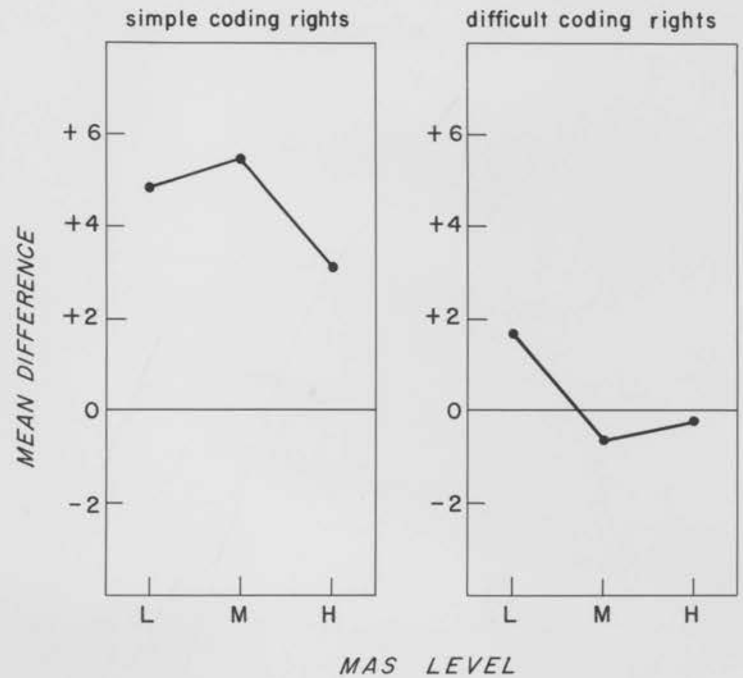
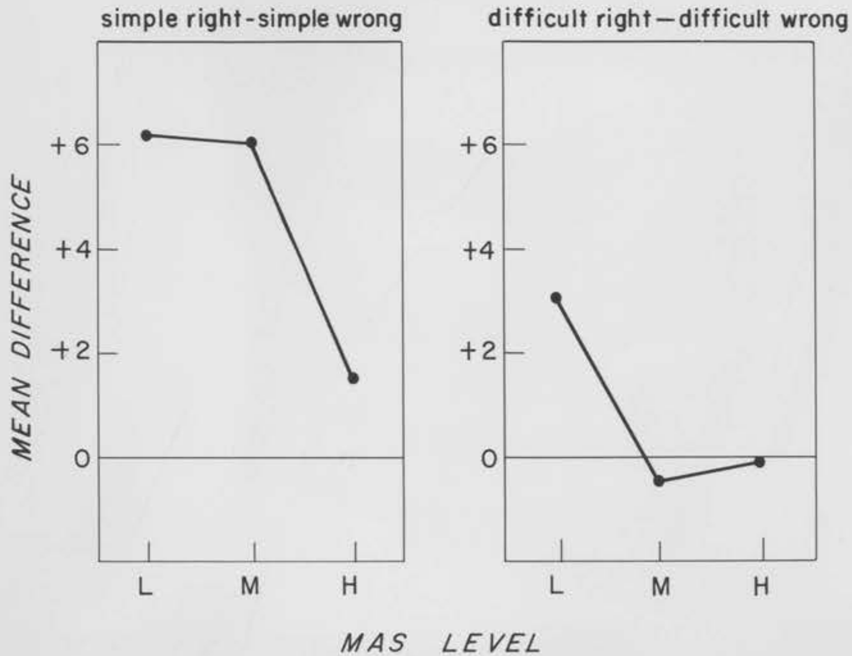


Figure 6a

DIGIT LETTER CODING TESTS - DRUG vs NO DRUG

+ = drug facilitates, − = drug impairs



6. <u>Drive Summation: The relationship between the combined effects of M.A.S. and drug upon the performance of the simple and the difficult digit-letter coding tests.</u>

a. Results:

As was noted earlier there were no significant differences between the performance of high and low M.A.S. subjects on either the simple or difficult digit letter coding tests. Under the no-drug condition there were only small differences in the performance of high and low M.A.S. subjects. Since differential predictions for the performance of high and low M.A.S. subjects were not confirmed and since the difficult coding test was not specifically developed to parallel the competitive paired-associates list the subsequent examination of drive summation is limited.

Paradigm 1a: If high M.A.S. level D1 as compared to low M.A.S. level leads to effect A and Effect A is superior performance on the simple digit-letter coding test, then high M.A.S. level D1, plus drug, D2, should lead to even more superior performance than that produced by D1 alone.

That is, performance as a function of D1 + D2 should be superior to performance as a function of D1 alone on the simple digit letter coding test.

Paradigm 1b: If high M.A.S. level, D1 and low M.A.S. level do not lead to differences in performance on effect B and effect B is performance on the difficult digit-letter coding test than high M.A.S. level D1, plus drug D2, should lead to no difference in performance as compared with that produced by D1 alone.

That is, performance as a function of D1 + D2 should not be different than performance as a function of D1 alone on the difficult digit-letter coding test.

Results:

The findings for the first paradigm are in the direction predicted, i.e., high M.A.S. subjects under the drug condition, D1 + D2, had a higher score on the simple test than did high M.A.S. subjects under the no-drug condition. See table XIII. This difference, (3.07), gave a t value of 1.12, p=n.s.

Discussion:

The results for the second paradigm were in the predicted direction, i.e., performance as a function of D1 + D2 was no different from performance as a function of D1. Since only small and non-significant differences in the performance of high and low M.A.S. subjects were found for the no-drug condition it would seem that D1 neither facilitates nor impairs performance on the difficult digit-letter coding test. In addition, if it is assumed that D1 is equivalent to a state of near maximum or maximum drive the addition of another drive, in this case D2, should have little if any effect upon performance not produced by D1 alone. As was noted in the first section the failure to obtain larger differences between performances under D1 + Dz and performance under D1 may be attributed to the possibility that high M.A.S., D1, subjects are already operating under maximum drive conditions. Amsel, 1950, failed to show a summation of pain and hunger drives. Amsel concluded that the pain stimulus, (electric shock), used in his experiment was far too strong for summation to be demonstrated, i.e., pain was producing maximum drive. The fact that drive summation was obtained by Amsel when hunger was combined with a conditioned pain-fear reaction lends support to the assumptions made by Amsel. If high M.A.S. subjects are already operating under maximum drive then drive summation should be more readily measured in the performance of low M.A.S. subjects.

Paradigm 2a) If low M.A.S. level D3 as compared with high M.A.S. level leads to effect C and effect C is inferior performance on the simple digit-letter coding test, then low M.A.S. level, D3, plus drug D4, should lead to more superior performance on the simple test than that produced by D3 alone.

That is, performance as a function of D3 + D4 should be superior to performance as a function of D3 alone.

Paradigm 2b: If low M.A.S. level D3, as compared with high M.A.S. level does not lead to differences in performance on the difficult digit-letter coding test then low M.A.S. level, D3, plus drug D4, should not lead to differences in performance as compared with that produced as a function of D3 alone.

That is, performance as a function of D3 and D4 should not be different than performance as a function of D3 alone on the difficult coding test.

The results for the third paradigm were in the predicted direction, i.e., the performance of low M.A.S. subjects under the drug condition, D3 + D4 was superior to the performance of low M.A.S. subjects under the no-drug condition. The difference in performance of the two groups was 4.82 as measured by Sr, and 6.18, as measured by Sr-Sw. These differences gave t values of 1.71, $p=.10$, and 1.90, $p=.10$, respectively. (See Tables XIII and XIV).

The results for the fourth paradigm were in the direction opposite to that predicted, i.e., the performance of low M.A.S. subjects under the drug condition D3 + D4, was superior to the performance of low M.A.S, D3, subjects under the no-drug condition. Although the difference between these two groups was 1.87 as measured by Dr, and 3.12 as measured by Dr-Dw these differences gave t values of only .63 and .84 respectively. (See tables XIII and XIV).

Discussion:

Four predictive paradigms of drive summation were examined. While tendencies in the direction of summation were noted these tendencies were in no instance significant. Summation was most clearly observed in the performance of low M.A.S. subjects under the drug condition. Figure 6 and Figure 6a show that low M.A.S. subjects were most facilitated by the drug, i.e., the drug improved their performance on both the simple and the difficult digit letter coding tests. As was noted in Section 1, the lack of drug effect found for high M.A.S. subjects can best be attributed to the fact that they are already performing under maximum drive.

SECTION III

ROTARY PURSUIT PERFORMANCE

Table XV presents the mean score in seconds on target during a 120 second trial, for each group, for each trial, and for the five trials combined on the rotary pursuit.

1. The relationship between M.A.S level and performance on the rotary pursuit.

   a. Results:

Table XV and Figure 7 reveal a tendency for middle M.A.S subjects to have lower scores than high and low M.A.S subjects on the pursuit rotor. Analyses of the differences in performance between low and middle M.A.S. subjects for trials 1, 2, 3, 4, and 5, and for the five trials combined gave t values of 2.37, 1.79, 1.41, 1.20, 1.04, and 1.61 respectively. Thus the only significant difference between the two groups was on the first trial. Figure 7 reveals that the performance of high M.A.S. subjects was intermediate to that of middle and low M.A.S. subjects.

   b. Discussion:

The results of the present study suggest that M.A.S. level does not influence performance on the pursuit rotor in the manner found for paired-associates learning. Furthermore, there were no systematic tendencies suggesting differences in performance between the three M.A.S. groups as was found for the two digit letter coding tests.

Matarazzo and Matarazzo, 1956, studied the relationship between

TABLE XV

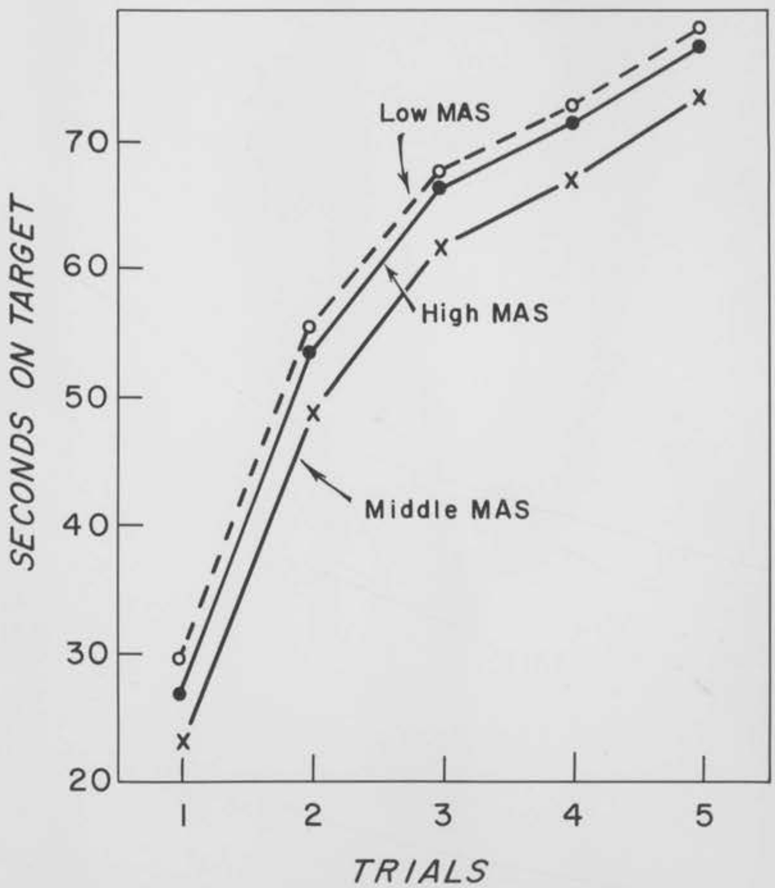
Pursuit Rotor Means

Seconds on Target

CONDITION	N	T1	T2	T3	T4	T5	TOTAL T1 - T5
No-Drug							
High M.A.S.	16	26.88	52.25	62.50	66.75	71.94	280.31
Middle M.A.S.	16	21.94	45.38	59.50	62.63	69.88	259.31
Low M.A.S.	16	27.06	51.25	64.50	67.44	73.00	283.25
Drug							
High M.A.S.	16	26.75	54.25	70.19	76.00	82.44	309.63
Middle M.A.S.	16	23.19	50.94	63.00	71.31	76.25	284.69
Low M.A.S.	16	32.35	59.50	69.94	77.81	84.50	324.00
Drug Plus No-Drug							
High M.A.S.	32	26.82	53.25	66.35	71.38	77.19	294.97
Middle M.A.S.	32	22.57	48.16	61.25	66.97	73.07	272.00
Low M.A.S.	32	29.66	55.38	67.22	72.63	78.75	303.63
3 M.A.S. Groups Combined							
No-Drug	48	25.29	49.63	62.17	65.61	71.61	274.29
Drug	48	27.40	54.90	67.71	75.05	81.06	306.11
		8.34%	10.62%	8.91%	14.39%	13.20%	11.6%

Figure 7

PURSUIT ROTOR PERFORMANCE



M.A.S. level and pursuit performance in a group of 80 psychiatric inpatients. Each subject was given 20 trials of 20 seconds each followed by a 40 second rest, on a complex double disk pursuit meter. They found a trend for subjects with M.A.S. scores of 9 to 24 to be "superior learners", but the results indicated no statistical relationship between performance and M.A.S. level. Since the subject sample, task, and length of trial, employed in the present study differed from those used by Matarazzo and Matarazzo, 1956, a direct comparison of experimental findings is difficult. It is of interest, nevertheless, to note that in both studies no relationship between M.A.S. level and performance was found. In addition, whereas the performance of middle M.A.S. subjects was quite similar to that of low M.A.S. subjects on both the paired-associates learning tasks and the digit letter coding tests, this was not the case for pursuit rotor performance.

2. The relationship between performance on the pursuit rotor under the drug versus no-drug conditions.

a. Results:

Table XV and Figure 8 reveal that subjects under the drug condition had higher scores on the pursuit rotor than did their no-drug counter parts. Analyses of the differences between drug and no-drug groups, combining across M.A.S. level, for trials 1, 2, 3, 4, 5, and for the five trials combined gave t values of .87, 1.72, 1.69, 2.73, 2.87 and 2.18 respectively. Thus, while the score for the drug group was not significantly, p=ns. superior to that of the no-drug group for the first trial, by the fourth trial the drug group had a significantly higher score, t=2.73, p=.01, than that of the no-drug group. Table XVI presents the between subjects analysis of variance for performance on the pursuit rotor. A comparison of drug and no-drug groups gave an F value of 4.74, p-.05,

Figure 8

PURSUIT ROTOR PERFORMANCE

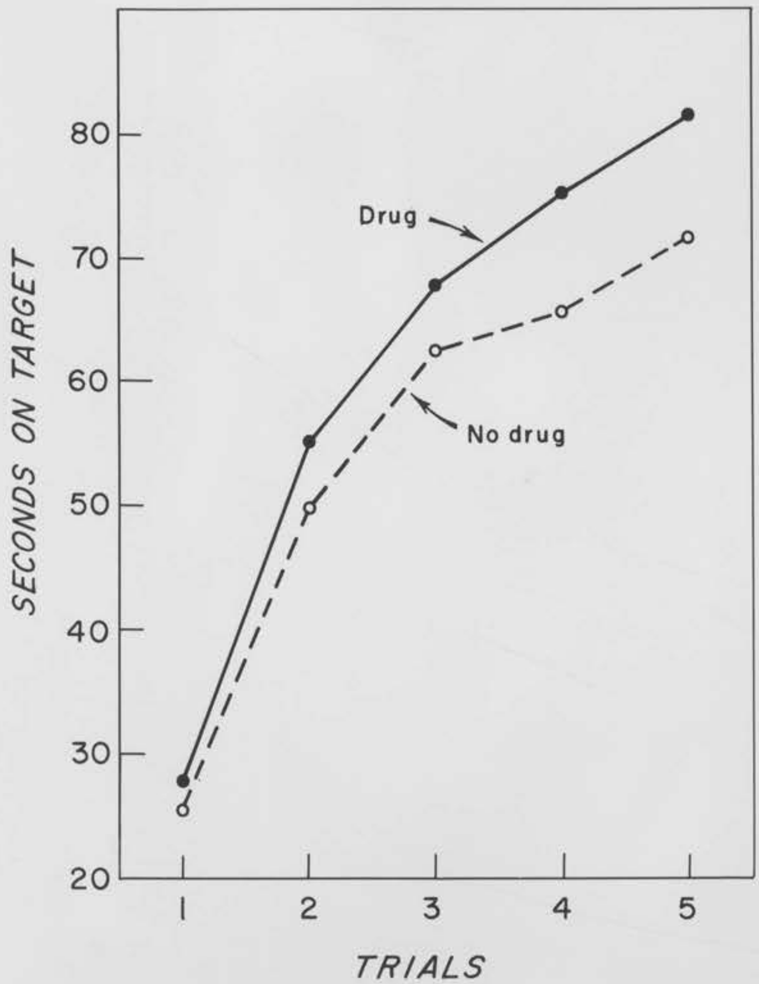


TABLE XVI

Pursuit Rotor Between Subject Analysis of Variance

Seconds on Target

Variable	dif.	sum of squares	mean square	F	p Value
(Drug vs. No-Drug)	1	4,857.77	4,857.77	4.74	$<.05$
(M.A.S.)	2	3,418.96	1,709.48	1.67	n.s.
(Drug vs. No-Drug) (M.A.S.)	2	204.11	102.06	.10	n.s.
Between Subjects Within Groups	90	92,325.41	1,025.84		
Total Between Subjects	95	100,806.25			

TABLE XVII

Pursuit Rotor Within Subject Analysis of Variance

Seconds on Target

Variable	dif.	sum of squares	mean square	F	p Value
(Trials)	4	150,830.15	37,707.54	1119.91	$<.0001$
(Drug vs. No-Drug) (Trials)	4	936.93	234.23	6.95	$<.001$
(M.A.S.) (Trials)	8	60.04	7.51	.22	n.s.
(M.A.S.) (Drug vs. No-Drug) (Trials)	8	276.00	34.50	1.02	n.s.
Within Subject Error	360	13,222.88	33.67		
Total Between Observations	479	266,132.25			

indicating the drug group had significantly higher scores than the no-drug group on the pursuit rotor. Table XVII presents the within subject analysis of variance for pursuit rotor performance. As may be seen in Table XVII all subjects improved over trials, (the trials variable gave an F value of 1,119.91, p .0001. The (drug vs. no-drug) x (trials) interaction gave an F value of 6.95, p=.001. This result indicates that the performance of the drug group significantly diverged over trials from that of the no-drug group.

b. Discussion:

The results of the present study indicate that the drug, amphetamine, significantly facilitated performance on the pursuit rotor. In addition, the performance curves for the two groups significantly diverged over trials, that is, the performance of the drug group became increasingly superior to that of the no-drug group with practice on the task. These findings are consistent with the earlier experimental literature. Barmark, 1939, found that 15 mg. of amphetamine sulfate retarded the development of inaccuracy when practised subjects were given a 2 hour trial on the Poffenberger pursuit meter. Payne and Hauty, 1953, 1955a, 1955b, found that d-amphetamine was the most effective agent for counteracting work decrement for a 4 hour work period on the USAF SAM multidimensional pursuit test. More recently Eysenck et. al., 1957, studied the effects of 10 mg. of d-amphetamine on pursuit rotor performance. They found that the drug increased performance as compared with the placebo group, and that this effect became more marked as the experiment proceeded.

GENERAL DISCUSSION

Of considerable interest in the present study was the finding that the drug, amphetamine, had a statistically significant effect on all three tasks, that is, the drug significantly facilitated learning on the simple paired-associates list, and performance on the simple digit-letter coding test and pursuit rotor. M.A.S. score on the other hand, was significantly related to performance on both paired-associates lists, revealed some tendency in the direction of influencing performance on the digit-letter coding tests and had no effect on pursuit rotor performance. In the present study then, the drug amphetamine effected a wider variety of performance than did M.A.S. level. M.A.S. level significantly effected performance only when the relative associative strengths of task relevant and task-irrelevant tendencies were controlled and manipulated as in paired-associates learning. In the present study the drug appears to have acted more as a non-specific drive factor in relation to performance than did M.A.S. level.

CHAPTER V

SUMMARY AND CONCLUSIONS

While most studies concerned with the relationship between drive level and performance have employed a single drive state, a few studies have examined the effects of the simultaneous action of two or more drive states on behavior. These studies have largely utilized animal subjects. Three classes of drive operations have been employed to study the relationship between drive and behavior in humans: induced muscle tension, drugs and score on Spence-Taylor Manifest Anxiety Scale. Moderate degrees of muscular tension have revealed facilitating effects upon a wide variety of behavior. (See Courts, 1942). Various drugs, particularly stimulants, have been shown to yield systematic changes in behavior. (See Weiss and Laties, 1962). Recently Spence, 1956, and his associates have suggested a new technique for investigating the relationship between drive level and behavior in human subjects. They assume that individual differences in drive level can be distinguished on the basis of subjects' scores on the Manifest Anxiety Scale, hereafter referred to as M.A.S., an inventory designed to measure manifest anxiety. Previous drug as well as M.A.S. studies have, however, been confined to performance on a single task. Moreover, M.A.S. studies have traditionally employed an experimental design utilizing independent subject samples, performing on simple and difficult tasks.

Accordingly, the present study was designed to provide some data on the extent to which M.A.S. level as a drive operation paralleled in its effects the generality of more traditional drive operations.

Thus, in contrast to previous studies the effect of M.A.S. level on the learning and performance of several different kinds of tasks was studied. Furthermore, since a questionable feature of previous studies on M.A.S. was the use of independent subject samples, the present study had all subjects perform on all the tasks, both at the simple and difficult levels. A further test of the drive status of M.A.S. level was provided by the use in the present experiment of the drug amphetamine, a condition known to have drive properties. This allowed an evaluation of the drive summation aspects of M.A.S. level.

Thus, the study focused specifically on the following experimental issues:

1) The nature of the relationship between M.A.S. score and the learning and performance of a variety of simple and complex tasks performed by the same subjects.

2) The extent to which amphetamine alone effects the learning and performance of these same tasks.

3) The nature of inter-relationships between the following variables: a) type of learning material, b) drug, c) M.A.S. score.

4) The nature of the combined effects of two drives on the performance of the various tasks.

Method and Procedure

Subjects: 96 male undergraduate students were assigned to either high, middle, or low M.A.S. groups on the basis of their scores on the Taylor Manifest Anxiety Scale. Half of the subjects in each of the three M.A.S. groups received amphetamine, (14 mg/70 kg of body weight), which was taken orally two hours prior to the experimental session. The other half received visually identical placebo capsules also taken two hours prior to reporting for the experimental session.

Apparatus and Materials: A Hull type memory drum, Lafayette model #303B, was emplyed to present the two lists of paired-associates. The successive stimulus items were exposed every 4 seconds with a 4 second interval between the successive presentations of the list. A 2 second anticipation interval was employed for both lists.

Two paired-associates lists. The simple or non-competitive list consisted of fifteen pairs of adjectives of high associative connection and low intra-list similarity. The difficult or competitive list consisted of twelve pairs of adjectives. These twelve pairs were broken into four triads; i.e., in each triad, one stimulus word is paired with a response word which is highly associated with all three stimulus words in that group, e.g., fearless - daring. The remaining two stimulus words are paired with response words of little or no associative strength, e.g., gallant - winged and valiant - burly.

Two digit-letter coding tests: a simple test and a difficult test.

Pursuit rotor: revolving at 33 r.p.m. Each subject had five 2 minute trials on the pursuit rotor.

Experimental Design: Eight orders of task presentation were employed. The use of eight test orders made the examination for interactions between order of task presentation, M.A.S. level, and drug possible. Analysis of variance revealed no significant relationships between order of task administration and either M.A.S. level or drug.

This was true for both paired-associates learning and digit-letter coding performance. While there were positive practice effects, these effects did not interact with either M.A.S. level or drug.

Performance measures: Paired-associates learning; trials to criterion, and errors to criterion on both the simple and difficult paired-associates lists. Since each subject learned both lists, it was possible to also derive a more sensitive test of the Spence-Taylor hypothesis; that is, that the performance of high M.A.S. subjects would be superior to that of low M.A.S. subjects on the non-competitive list, and that the reverse would be true for performance on the competitive paired-associates list. To obtain this measure, each subject's performance score on the non-competitive list was subtracted from his performance score on the competitive list to yield a difference score, hereafter referred to as the DS value.

Digit-letter coding tests; number right, number wrong, number right minus number wrong, and a DS value obtained in the same way as in the case of paired-associates learning.

Pursuit rotor; number of seconds on target during a 120 second trial.

1. Paired-Associates Learning

Results and Discussion

The relationship between M.A.S. level and performance on the non-competitive and competitive paired-associates lists under the no-drug condition.

On the non-competitive list, high M.A.S. subjects required significantly fewer trials to criterion than did low M.A.S. subjects. On the competitive list low M.A.S. subjects required significantly fewer trials than did their high M.A.S. counterparts. High M.A.S. subjects had a significantly larger DS value for trials to criterion than did middle or low M.A.S. subjects.

The results of the present study are in accord with the findings of Spence et. al., 1956a and Spence et. al., 1956b. In addition, the present study, by employing a correlated sample, confirmed at a significant level the differential prediction that high M.A.S. subjects are superior to low M.A.S. subjects on the non-competitive list and that low M.A.S. subjects are superior to high M.A.S. subjects on the competitive list.

The relationship between M.A.S. level and performance on the non-competitive and competitive paired-associates lists under the drug condition.

In contrast with the no-drug condition, the differences between high and low M.A.S. subjects, while in the same direction, were in no case significant.

The empirical relationships between M.A.S. level and performance under the drug condition paralleled those found for the no-drug condition but the differences between high and low M.A.S. subjects were not significant.

The relationship between M.A.S. level and performance on the non-competitive and competitive paired-associates lists under the combined no-drug and drug conditions.

As was the case for the no-drug condition, the differences between high and low M.A.S. subjects were significant for both lists. In addition, the differences between high and middle M.A.S. subjects on the non-competitive list were also significant. High M.A.S. subjects had a significantly larger DS value for trials to criterion than did middle or low M.A.S. subjects. The present study also adds evidence to the effect that the performance of middle M.A.S. subjects falls closer to that of low M.A.S. subjects than that of high M.A.S. subjects.

The findings for the combined drug and no-drug condition reveal the same significant differences between high and low M.A.S. subjects as was found for the no-drug condition. In addition, the present study adds evidence to the effect that the performance of middle M.A.S. subjects falls closer to that of low M.A.S. subjects than that of high M.A.S. subjects. Significant differences between the performance of high and middle M.A.S. subjects were found. The results of the present study support the assumption that the Taylor Manifest Anxiety Scale can distinguish only the highest scores from the rest of the scores in the distribution.

The relationship between performance on the non-competitive and competitive paired-associates lists under drug vs. no-drug conditions without regard to M.A.S. level.

On the non-competitive list subjects under the drug condition required significantly fewer trials to criterion than did no-drug subjects. On the competitive list there was little or no difference between the performance of drug and no-drug subjects.

The findings of the present study suggest that the effects of the drug upon performance of the non-competitive list are similar to the effects produced by high M.A.S. level. The drug, however, had little or no effect upon the performance of the competitive list.

The relationship between performance on the non-competitive and the competitive lists under the drug vs. the no-drug condition within each of the M.A.S. groups considered separately.

On the non-competitive list, the degree of amphetamine facilitation was inversely related to M.A.S. level, that is, low M.A.S. subjects received more facilitation from the drug than did high M.A.S. subjects. On the competitive list, drug facilitation was directly related to M.A.S. level, that is, low M.A.S. subjects were somewhat impaired, while high M.A.S. subjects were somewhat facilitated by the drug. There were, however, no significant relationships between M.A.S. level, drug and performance.

The inter-relationship, (interaction), between M.A.S. level and drug effect was not significant. The drug facilitated the performance of all M.A.S. groups on the non-competitive list. The performance of low and middle M.A.S. subjects was more facilitated by the drug than that of high M.A.S. subjects. On the competitive list, the degree of drug facilitation was directly related to M.A.S. level. The effects of M.A.S. level on the performance of the two lists were discussed under four paradigms of drive summation. While there were tendencies in the direction of drive summation, these trends were most clearly observed in the performance of low M.A.S. subjects under the drug condition.

2. Digit-Letter Coding Test Performance

Results and Discussion

<u>The relationship between M.A.S. level and performance on the digit-letter coding test under the no-drug condition.</u>

High M.A.S. subjects had more rights on the simple coding test than did middle or low M.A.S. subjects, and low and middle M.A.S. subjects had more rights than high M.A.S. subjects on the difficult coding test. In no case were any of the above differences significant.

The results of the present study suggest that M.A.S. level does not influence performance on the digit-letter coding tests in a significant manner as it did in the case of paired-associates learning.

<u>The relationship between M.A.S. level and performance on the digit-letter coding tests under the drug condition.</u>

The empirical relationships between M.A.S. level and performance under the drug condition paralleled those found for the no-drug condition. The differences between high and low M.A.S. subjects were not significant.

For the most part, performance under the drug condition paralleled that found for the no-drug condition. The two major effects of drug action were to: 1. reduce the differences in performance on the simple test, by the three M.A.S. groups, and 2. increase the performance differences of high and low M.A.S. subjects on the difficult test.

<u>The relationship between M.A.S. level and performance on the digit-letter coding tests under the combined drug and no-drug conditions.</u>

On the simple coding test, subjects under the drug condition had significantly more rights than did their no-drug counterparts.

On the difficult coding test, there was little or no difference in the performance of the two groups.

The findings of the present study are in agreement with the relevant literature, that is, the drug significantly facilitated the performance of the simple coding test but had little or no effect on the performance of the difficult coding test.

The relationship between performance on the digit-letter coding tests under the drug vs. the no-drug condition within each of the three M.A.S. groups considered separately.

On both the simple and the difficult coding tests the degree of drug facilitation was inversely related to M.A.S. level. There were, however, no statistically significant differences between drug and no-drug subjects within each of the three M.A.S. groups considered separately. In addition, there were no significant relationships between M.A.S. level and drug effect.

Low M.A.S. subjects received more facilitation from the drug than did high M.A.S. subjects for both the simple and the difficult tests. The relationship between M.A.S. level and drug effect was examined under four paradigms of drive summation.

3. Pursuit Rotor

Results and Discussion

No tendencies with respect to performance differences on the part of high, middle or low M.A.S. subjects were noted. The two major findings were: 1. that the drug group was significantly superior to the no-drug group, as measured by time on target; and 2. that there was a significant relationship between drug effect and practice, that is, the performance curves of drug and no-drug groups diverged over trials.

Failure to obtain differences in performance between M.A.S. groups on the pursuit rotor have been reported by Matarazzi and Matarazzi, 1956, for a population of psychiatric inpatients. The results of the present study indicate that M.A.S. level does not lead to differences in performance on the pursuit rotor. The findings with respect to the effect of amphetamine upon pursuit rotor performance are in accord with results obtained by Eysenck et. al., 1957, who employed the same drug and the same task, as well as others using different but similar tasks, Payne and Hauty, 1953, 55a, 55b.

Overall Results

The overall findings for the effect of M.A.S. alone are as follows: 1) M.A.S. had a statistically significant effect on the learning of both the simple and difficult paired-associates lists. 2) The Spence-Taylor differential hypothesis that high M.A.S. subjects would be superior on the simple list and that low M.A.S. subjects would be superior on the difficult list was confirmed. 3) M.A.S. level did not have a statistically significant effect on the performance of the two digit-letter coding tests. While there were tendencies for the high M.A.S. group to be superior on the simple test and for the low M.A.S. group to be superior on the difficult test, these differences were not statistically significant. 4) Finally, M.A.S. level did not affect performance on the pursuit rotor. 5) The performance of middle M.A.S. subjects fell closest to that of the low M.A.S. group on paired-associates learning, and digit-letter coding performance, but was closer to that of the high M.A.S. group on the pursuit rotor.

When examining the independent effects of the drug, we note the following: 1) The drug, amphetamine, facilitated, (p=.05), learning on the simple paired-associates list, and 2) performance, (p=.01), on the simple digit-letter coding test, but had no effect on the difficult versions of these two tasks. 3) Amphetamine significantly, (p=.05), facilitated performance on the pursuit rotor, and this effect became more marked, (p=.001), with increased trials on the rotor.

The results relating to the combined effects of drug and M.A.S. level, while not statistically significant, showed the following trends: 1) The drug amphetamine facilitated learning for all M.A.S. groups on the simple paired-associates list. The greatest degree of facilitation due to the drug was noted in the performance of the low M.A.S. group. 2) While the drug had little or no effect on learning of the difficult list for the high and middle M.A.S. groups, the learning of this list by the low M.A.S. group was somewhat impaired by the drug. 3) The drug facilitated the performance of all three M.A.S. groups on the simple digit-letter coding test, but had its most marked effect on the performance of the low M.A.S. group. 4) The performance of low M.A.S. subjects was also most facilitated by the drug on the difficult digit-letter coding test.

General Conclusions and Discussion

1) The present study confirmed the results of previous investigators using independent samples on paired-associates tasks. 2) Furthermore, the results of the present study are in agreement with the small number of previous studies employing a middle M.A.S. group in demon-

strating that the Taylor Scale is simply a dichotomous measure rather than a continuous scale.

3) The major finding of the present study was the limited area of the drive effects of M.A.S. level as compared to the effects of the second drive, the drug amphetamine. Amphetamine had statistically significant effects on all three tasks, that is, the drug significantly facilitated learning on the simple paired-associates list, and performance on the simple digit-letter coding test and pursuit rotor. M.A.S. level, on the other hand, was significantly related only to performance on both paired-associates lists, showed some tendency in the direction of influencing performance on the digit-letter coding tests, and had no effect on pursuit rotor performance. In the present study then, the drug amphetamine was more successful than M.A.S. level in affecting performance on a wide variety of tasks. M.A.S. level significantly affected performance only when the relative associative strengths of task-relevant and task irrelevant tendencies were controlled and manipulated, that is, paired-associates learning. In the present study then, the drug amphetamine appears to have acted more as a non-specific drive factor in relation to performance than did M.A.S. level.

APPENDIX I

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. 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. 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 not true at all, blacken the space in column F in the numbered row. 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 is 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. Mark each item as you come to it; be sure to mark one; and only one, answer space for each item.

1) I am often sick to my stomach.

2) I think a great many people exaggerate their misfortunes in order to gain the sympathy and help of others.

3) I do not tire quickly.

4) I have had very few quarrels with members of my family.

5) I am about as nervous as other people.

6) I would rather win than lose in a game.

7) I have very few headaches.

8) I worry over money and business.

9) I work under a great deal of strain.

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

11) I cannot keep my mind on one thing.

12) I do not like everyone I know.

13) I have diarrhea ("the runs") once a month or more.

14) I am against giving money to beggers.

15) I frequently notice my hand shakes when I try to do something.

16) I find it hard to make talk when I meet new people.

17) I blush as often as others.

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

19) I have nightmares every few nights.

20) People often disappoint me.

21) I worry quite a bit over possible troubles.

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

23) I practically never blush.

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

25) I am often afraid that I am going to blush.

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

27) My hands and feet are usually warm enough.

28) I often find myself worrying about something.

29) I sweat very easily even on cool days.

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

31) When embarrassed I often break out in a sweat which is very annoying..

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

33) I do not often notice my heart pounding and I am seldom short of breath.

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

35) I feel hungry almost all the time.

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

37) Often my bowels don't move for several days at a time.

38) At times I feel like swearing.

39) I have a great deal of stomach trouble.

40) At times I am full of energy.

41) At times I lose sleep over worry.

42) I do not read every editorial in the newspaper every day.

43) My sleep is restless and disturbed.

44) Criticism or scolding hurts me terribly.

45) I often dream about things I don't like to tell other people.

46) I have often felt that I faced so many difficulties I could not overcome them.

47) I am easily embarassed.

48) Sometimes when I am not feeling well I am cross.

49) My feelings are hurt easier than most people.

50) I often think "I wish I were a child again."

51) I wish I could be as happy as others.

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

53) I am usually calm and not easily upset.

54) I cry easily.

55) I certainly feel useless at times.

56) I feel anxious about something or someone almost all of the time.

57) At times I feel like smashing things.

58) I am happy most of the time.

59) Once in a while I laugh at a dirty joke.

60) It makes me nervous to have to wait.

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

62) At times I am so restless that I cannot sit in a chair for very long.

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

64) Sometimes I become so excited that I find it hard to get to sleep.

65) I do not always tell the truth.

66) At times I have been worried beyond reason about something that really did not matter.

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

68) I do not have as many fears as my friends.

69) What others think of me does not bother me.

70) I have been afraid of things or people that I knew could not hurt me.

71) I get angry sometimes.

72) I find it hard to keep my mind on a task or job.

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

74) I am more self-conscious than most people.

75) I like to let people know where I stand on things.

76) I am the kind of person who takes things hard.

77) I gossip a little at times.

78) I am a very nervous person.

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

80) Life is often a strain to me.

81) I get mad easily and get over it soon.

82) At times I think I am no good at all.

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

84) I am not at all confident of myself.

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

86) At times I feel that I am going to crack up.

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

88) I don't like to face a difficulty or make an important decision.

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

90) I am very confident of myself.

APPENDIX IIa*

Stimulus word	Response word	M	A	V	F
Agile	Nimble	1.6	1.5	3.3	0.7
Gloomy	Dismal	1.6	1.1	2.6	0.6
Empty	Vacant	1.1	1.0	4.4	0.5
Tranquil	Quiet	1.5	1.0	2.7	0.6
Mammoth	Oversize	2.5	1.4	3.3	0.5
Healthy	Wholesome	1.9	1.5	3.4	0.6
Frigid	Icy	1.9	1.3	2.2	0.5
Idle	Lazy	2.9	1.8	3.7	0.5
Joyous	Merry	1.5	1.3	2.2	0.6
Complete	Entire	0.9	1.5	5.4	0.5
Distant	Far-off	1.0	1.1	4.6	0.5
Pleasant	Genial	1.7	1.7	3.2	0.9
Sacred	Holy	0.9	0.7	2.4	0.5
Nomad	Roving	1.8	1.5	3.2	0.9
Urgent	Pressing	1.4	1.3	3.2	0.6
	Means	1.6	1.3	3.3	0.6

Legend: M - similarity of meaning, 0.5 maximal, 6.5 minimal

A - closeness of associative connection, o.5 maximal, 6.5 minimal

V - vividness of connection, 0.5 maximal, 6.5 minimal

F - familiarity, 0.5 maximal, 4.5 minimal

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* The pairs of adjectives in tables II and III came from Haggens' word list, 1949.

APPENDIX IIb

Stimulus word	Response word
outworn I	vocal
desert II	polished
fearless III	daring*
undersized IV	ardent
little IV	minute*
ragged I	threadbare*
gallant III	winged
arid II	jaded
valiant III	burly
tattered I	brave
barren II	fruitless*
petite IV	giddy

Legend: * = adjective pairs of high associative connection.

APPENDIX IIc

On the next page you will find 20 rows of letters. Scattered at random points in these rows you will find numbers. These numbers instruct you concerning the way you are to respond to the letters following them.

The number 2 tells you to circle every small letter between it and the next number.

The number 3 tells you to circle every large letter between it and the next number.

The number 4 tells you to underline each of the large letters between it and the next number.

The number 5 tells you to put a check on top of each of the small letters between it and the next number.

The number 6 tells you to put a check on top of each of the large letters between it and the next number.

The number 7 tells you to underline each of the small letters between it and the next number.

Look at the two rows of numbers and letters in the example below. Note that seven letters follow the 2 which begins the first row; four of these are small letters. You should circle each of the four small letters and do nothing to the three large letters. The next number you find is 6. It instructs you to put a check on top of each of the large letters between it and the next number. The next number you find is number 7 so you would put a line under each of the small letters following it. The next number is 3 so you would circle each of the following large letters.

Example:

2 a C d m B L g 6 t p o R S n g j D V s 7 B d o L e f p 3 B X y Z u b

4 d P q r M d B 7 W b g J p 6 E m N a 5 Z v p L k f h B t 2 V W m L t

Take the test in order; do not skip around; as soon as you finish the top row, go to the 2nd row, then to the 3rd row, etc. This is a timed test; so work rapidly. However, try to be accurate as well as fast.

APPENDIX IIc

2 circle small letters
3 circle large letters
4 underline large letters
5 check on top of small letters
6 check on top of large letters
7 underline small letters

Form A

NAME________________________

DATE___________SESSION___________

6 b K n d 2 J k o m B 4 b E n b m C Z H 7 h A K V P h k z Q 3 t D c Z U V h

7 j H R y b V 3 w G Z n f 4 L G N v c 5 X b p 3 X M r K h 2 M e N o t b n H

4 h A i N X C v u 5 Y J H L z 2 e Z d 6 t Y J V t m L m n 5 s H F w 4 m W E

5 y x w i Q 7 y N J 6 B J r h K A Z 3 w R E j g 2 Z H M u n D 7 i e a M s F

2 d L t 5 J C v 6 o R V K D 3 s P m 7 j V M L k D j x v 6 P c s d 4 E i o R

5 k v M F D 3 C M a Y g i X g 7 j S j 4 P R s k Y n E N 2 J Q h x G M F M i

4 t R w q W g U 2 p b R d K 5 y i S k b E N d 4 o G c 6 t S L Q z n 7 G o E

3 y t R 7 j M a n b s K P 6 v p E d z h E S f 5 h e T C y M L q F 3 a q w E

5 f Q r 2 X r c N K 3 j u e z S c s B 4 N P c q U 7 b y L H o B H A 5 A X h

6 j g Q b 7 n L J T x 6 m v A K 2 o h S Q 7 L a t y Q 4 j f k H b F 2 y a H

5 R M a s L 2 M J m S c 4 a k r T L D 5 V C j L B J w x 3 R Y j s p x C N F

2 w Z a k 7 E r R i 5 e B D C i 6 x y N 3 F Q Y k e i H 6 t g B X R 4 F J n

6 R H s D i r L j 4 k S L o b 5 h S u W 2 K w X v g z 7 a D Z E c j 3 T m v

5 F C b P G n 7 C z U 6 g j A D N K b Q 3 j u G c e 2 i Q F E 4 f k E T v E

7 L n R 2 e j K m 4 E T g M f n e 6 P n b t w Q 5 v Y n 3 h u h D B 7 M Z g

6 H c j k L 5 Q S j Q 4 s U V B g 2 J y L n y J 7 D f G 5 E R G z D 4 S n S

6 s a H 4 L B L J d p C R 3 d H b 7 H x a D e x o Q F 5 N B s C s 6 P N f D

7 v F c T 2 y L b s h n Q 3 n F Q L M 2 a i H 4 g y L h c 7 d e P f S e h D

3 K s i y 2 N E b a F t x V 4 q w X 2 X u G w r 6 L V i y d Y D q 3 M r b t

6 n S L 5 L u Z j K m d 3 J o N K J 7 k Y N 5 L q E j 2 y J a r s e 4 S j v

APPENDIX IId

On the next page you will find 20 rows of letters. Scattered at random points in these rows you will find numbers. These numbers instruct you concerning the way you are to respond to the letters following them.

The number 2 tells you to circle every small letter between it and the next number.

The number 3 tells you to circle every large letter between it and the next number.

The number 4 tells you to underline each of the large letters between it and the next number.

The number 5 tells you to put a check on top of each of the small letters between it and the next number.

The number 6 tells you to put a check on top of each of the large letters between it and the next number.

The number 7 tells you to underline each of the small letters between it and the next number.

On every odd number (1,3,5,7) do not respond to the first otherwise appropriate letter in each block.

On every even number (2,4,6) do not respond to the last otherwise appropriate letter in each block.

When there is only one appropriate letter in a block do not respond to that letter i.e. 3 d H b.

Look at the two rows of numbers and letters in the example below. Note that seven letters follow the 2 which begins the first row; four of these are small letters. You should circle a, d, m, but not g and do nothing to the three large letters. The next number you find is 6. You should check R, S, D but not V. The next number you find is number 7 so you would put a line under each of the small letters following it except letter d. The next number is 3 so you would circle each of the following large letters except letter B.

Example:

2 a C d m B L g 6 t p o R S n g j D V w 7 B d o L e f p 3 B X y Z u b

4 d P q r M d B 7 W b g J p 6 E m N a 5 Z v p L k f h B t 2 V W m L t

Take the test in order; do not skip around; as soon as you finish the top row, go to the 2nd row, then to the 3rd row etc. This is a timed test; so work rapidly. However, try to be accurate as well as fast.

ANALYSIS OF VARIANCE

Non-Competitive Paired-Associates Trials to Criterion

	df	sum of squares	mean square	F	p Value
Drug vs. No-Drug	1	27.09	27.09	3.89	.05
M.A.S.	2	61.40	30.80	4.43	.05
(Drug vs. No-Drug)(M.A.S.)	2	5.07	2.54	.22	n.s.
Practice	1	38.76	38.76	5.56	.01
Order	2	6.77	3.38	.49	n.s.
(Drug vs. No-Drug)(Practice)	1	.26	.26	.04	n.s.
(Drug vs. No-Drug)(Order)	2	9.86	4.93	.71	n.s.
(M.A.S.)(Practice)	2	2.65	1.33	.19	n.s.
(M.A.S.)(Order)	4	21.29	5.32	.76	n.s.
(Drug vs. No-Drug)(M.A.S.)(Practice)	2	13.65	6.83	.98	n.s.
(Drug vs. No-Drug)(M.A.S.)(Order)	4	7.19	1.80	.26	n.s.
Within Error	72	501.25	6.96		
Total	95	695.24			

ANALYSIS OF VARIANCE

Competitive Paired-Associates Trials to Criterion

	df	sum of squares	mean square	F	p Value
Drug vs. No-Drug	1	8.17	8.17	.37	n.s.
M.A.S.	2	184.34	92.17	4.21	.05
(Drug vs. No-Drug)(M.A.S.)	2	10.58	5.29	.24	n.s.
Practice	1	192.67	192.67	8.79	.01
Order	2	3.54	1.77	.08	n.s.
(Drug vs. No-Drug)(Practice)	1	2.04	2.04	.09	n.s.
(Drug vs. No-Drug)(Order)	2	128.21	64.11	2.93	n.s.
(M.A.S.)(Practice)	2	.08	.04	--	n.s.
(M.A.S.)(Order)	4	49.33	12.33	.56	n.s.
(M.A.S.)(Drug vs. No-Drug)(Practice)	2	9.09	4.55	.21	n.s.
(M.A.S.)(Drug vs. No-Drug)(Order)	4	126.41	31.60	1.44	n.s.
Within Error	72	1577.50	21.91		
Total	95	2291.96			

APPENDIX IIIa

Table III - Analysis of Variance

Difficult List - Simple List

Trials to Criterion

Variable	dif.	sum of squares	mean square	f	p Value
(P1, P2)	1	404.26	404.26	12.83	<.001
(DS) (Drug vs. No-Drug)	1	65.01	65.01	2.06	n.s.
(DS) (M.A.S.)	2	458.32	229.16	7.27	<.001
(DS) (M.A.S.) (Drug vs. No-Drug)	2	30.27	15.14	.48	n.s.
(P1, P2) (DS) (M.A.S.)	2	1.90	.85	.03	n.s.
(P1, P2) (DS) (Drug vs. No-Drug)	1	.84	.84	.03	n.s.
(P1, P2) (DS) (M.A.S.) (Drug vs. No-Drug)	2	32.69	16.35	.52	n.s.
Within Error	72	2268.75	31.51		
Total	95				

(P1, P2): P1 = subjects who had the difficult paired-associates list first.
P2 = subjects who had the simple paired-associates list first.
P1 subjects had a significantly larger difference score than did P2 subjects.

(DS): trials to criterion on difficult list minus trials to criterion on simple list.

ANALYSIS OF VARIANCE

Simple Coding Rights

	df	sum of squares	mean square	F	p Value
Drug vs. No-Drug	1	481.51	481.51	7.88	.01
M.A.S.	2	106.58	53.29	.87	n.s.
(Drug vs. No-Drug)(M.A.S.)	2	26.33	13.17	.22	n.s.
Practice	1	237.54	237.54	3.89	.05
Order	2	65.08	32.54	.53	n.s.
(Drug vs. No-Drug)(Practice)	1	.84	.84	.01	n.s.
(Drug vs. No-Drug)(Order)	2	175.53	87.77	1.44	n.s.
(M.A.S.)(Practice)	2	95.59	47.80	.78	n.s.
(M.A.S.)(Order)	4	122.58	30.65	.50	n.s.
(M.A.S.)(Drug vs. No-Drug)(Practice)	2	33.27	16.64	.27	n.s.
(M.A.S.)(Drug vs. No-Drug)(Order)	4	330.64	82.66	1.35	n.s.
Within Error	72	4396.75	61.07		
Total	95	6072.24			

ANALYSIS OF VARIANCE

Difficult Coding Rights

	df	sum of squares	mean square	F	p value
Drug vs. No-Drug	1	3.01	3.01	.05	n.s.
M.A.S.	2	42.19	21.10	.33	n.s.
(Drug vs. No-Drug)(M.A.S.)	2	39.03	19.52	.30	n.s.
Practice	1	283.59	283.59	4.39	.05
Order	2	92.86	46.43	.72	n.s.
(Drug vs. No-Drug)(Practice)	1	11.34	11.34	.18	n.s.
(Drug vs. No-Drug)(Order)	2	57.28	28.64	.44	n.s.
(M.A.S.)(Practice)	2	251.69	125.85	1.95	n.s.
(M.A.S.)(Order)	4	579.71	144.93	2.24	n.s.
(Drug vs. No-Drug)(M.A.S.)(Practice)	2	43.94	21.97	.34	n.s.
(Drug vs. No-Drug)(M.A.S.)(Order)	4	543.77	185.94	2.10	n.s.
Within Error	72	4649.75	64.58		
Total	95	6598.16			

APPENDIX IIIb

Table III - Analysis of Variance

Simple Coding Test Number Right - Difficult Coding Test Number Right

Variable	dif.	sum of squares	mean square	f	p Value
(P1, P2)	1	981.76	981.76	10.63	$<.01$
(DS) (Drug vs. No-Drug)	1	364.26	364.26	3.94	$<.05$
(DS) (M.A.S.)	2	268.15	134.08	1.45	n.s.
(DS) (M.A.S.) (Drug vs. No-Drug)	2	60.02	30.01	.32	n.s.
(P1, P2) (DS) (M.A.S.)	2	199.52	99.76	1.08	n.s.
(P1, P2) (DS) (Drug vs. No-Drug)	1	12.76	12.76	.14	n.s.
(P1, P2) (DS) (M.A.S.) (Drug vs. No-Drug)	2	166.40	88.20	.90	n.s.
Error	72	6649.25	92.35		

(P1, P2): P1 = subjects who had the difficult test first.
P2 - subjects who had the simple test first.
P1 subjects had a significantly larger difference score than did P2 subjects.

(DS): subject's score on the simple test minus his score on the difficult test.

APPENDIX IVa

Errors to Criterion for Paired-Associates Learning

CONDITION	SIMPLE LIST		DIFFICULT LIST		DIFFICULT-SIMPLE LIST	
No-Drug	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
High M.A.S.	16.75	10.05	112.81	39.87	96.06	36.47
Middle M.A.S.	20.19	7.69	101.06	33.95	80.88	35.67
Low M.A.S.	23.94	12.91	93.06	32.83	69.13	37.93
Drug						
High M.A.S.	15.38	12.08	106.88	32.96	91.50	31.04
Middle M.A.S.	18.25	10.21	99.31	29.61	81.06	31.11
Low M.A.S.	22.00	11.56	97.50	26.07	75.50	32.19
No-Drug Plus Drug						
High M.A.S.	16.06	11.13	109.84	36.79	93.78	33.96
Middle M.A.S.	19.22	9.09	100.19	31.86	80.97	33.47
Low M.A.S.	22.97	12.30	95.28	29.72	72.31	35.33
3 M.A.S. Groups Combined						
No-Drug	20.29	10.84	102.31	36.59	82.02	38.34
Drug	18.54	11.63	101.23	30.03	82.69	32.15

APPENDIX IVb

Paired-Associates Learning for High, Middle and Low M.A.S. Subjects Under the No-Drug Condition

Errors to Criterion

CONDITION	SIMPLE LIST		DIFFICULT LIST		DIFFICULT-SIMPLE LIST	
No-Drug	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
High M.A.S.	16.75	10.05	112.81	39.87	96.06	36.47
Middle M.A.S.	20.19	7.69	101.06	33.95	80.88	35.67
Low M.A.S.	23.94	12.91	93.06	32.83	69.13	37.93

SIMPLE PAIRED-ASSOCIATES LIST

	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	7.19	1.70	.10
High M.A.S. vs. Middle M.A.S.	3.44	1.05	n.s.
Middle M.A.S. vs. Low M.A.S.	3.75	.96	n.s.

DIFFICULT PAIRED-ASSOCIATES LIST

	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	19.75	1.48	n.s.
High M.A.S. vs. Middle M.A.S.	11.75	.87	n.s.
Middle M.A.S. vs. Low M.A.S.	8.00	.66	n.s.

DIFFICULT-SIMPLE PAIRED-ASSOCIATES LISTS

	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	26.93	1.98	.05
High M.A.S. vs. Middle M.A.S.	15.18	1.15	n.s.
Middle M.A.S. vs. Low M.A.S.	11.75	.87	n.s.

APPENDIX IVc

Paired-Associates Learning for High, Middle and Low M.A.S. Subjects Under the Drug Condition

Errors to Criterion

CONDITION	SIMPLE LIST		DIFFICULT LIST		DIFFICULT-SIMPLE LIST	
Drug	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
High M.A.S.	15.38	12.08	106.88	32.96	91.50	31.04
Middle M.A.S.	18.25	10.21	99.31	29.61	81.06	31.11
Low M.A.S.	22.00	11.56	97.50	26.07	75.50	32.19

SIMPLE PAIRED-ASSOCIATES LIST

	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	6.62	1.53	n.s.
High M.A.S. vs. Middle M.A.S.	2.87	.70	n.s.
Middle M.A.S. vs. Low M.A.S.	3.75	.94	n.s.

DIFFICULT PAIRED-ASSOCIATES LIST

	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	9.38	.86	n.s.
High M.A.S. vs. Middle M.A.S.	7.57	.66	n.s.
Middle M.A.S. vs. Low M.A.S.	1.81	.18	n.s.

DIFFICULT-SIMPLE PAIRED-ASSOCIATES LISTS

	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	16.00	1.38	n.s.
High M.A.S. vs. Middle M.A.S.	10.44	.92	n.s.
Middle M.A.S. vs. Low M.A.S.	5.56	.48	n.s.

APPENDIX IVd

Paired-Associates Learning for High, Middle and Low M.A.S. Subjects Under the Combined No-Drug and Drug Conditions

Errors to Criterion

CONDITION	SIMPLE LIST		DIFFICULT LIST		DIFFICULT-SIMPLE LIST	
No-Drug Plus Drug	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
High M.A.S.	16.06	11.13	109.84	36.79	93.78	33.96
Middle M.A.S.	19.22	9.09	100.19	31.86	80.97	33.47
Low M.A.S.	22.97	12.30	95.28	29.72	72.31	35.33

SIMPLE PAIRED-ASSOCIATES LIST

	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	6.91	2.32	.05
High M.A.S. vs. Middle M.A.S.	3.75	1.35	n.s.
Middle M.A.S. vs. Low M.A.S.	3.16	1.23	n.s.

DIFFICULT PAIRED-ASSOCIATES LIST

	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	14.56	1.71	.10
High M.A.S. vs. Middle M.A.S.	4.91	.63	n.s.
Middle M.A.S. vs. Low M.A.S.	9.69	1.11	n.s.

DIFFICULT-SIMPLE PAIRED-ASSOCIATES LISTS

	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	21.47	2.41	.02
High M.A.S. vs. Middle M.A.S.	8.66	.99	n.s.
Middle M.A.S. vs. Low M.A.S.	12.81	1.49	n.s.

APPENDIX IVe

Paired-Associates Learning for High, Middle and Low M.A.S. Subjects, and for the Three Groups Combined Under Drug vs. No-Drug Conditions

Errors to Criterion

CONDITION	SIMPLE LIST		DIFFICULT LIST		DIFFICULT-SIMPLE LIST	
No-Drug	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
High M.A.S.	16.75	10.05	112.81	39.87	96.06	36.47
Middle M.A.S.	20.19	7.69	101.06	33.95	80.88	35.67
Low M.A.S.	23.94	12.91	93.06	32.83	69.13	37.93
Drug						
High M.A.S.	15.38	12.08	106.88	32.96	91.50	31.04
Middle M.A.S.	18.25	10.21	99.31	29.61	81.06	31.11
Low M.A.S.	22.00	11.56	97.50	26.07	75.50	32.19
3 M.A.S. Groups Combined						
No-Drug	20.29	10.84	102.31	36.59	82.02	38.34
Drug	18.54	11.63	101.23	30.03	82.69	32.15

	SIMPLE LIST			DIFFICULT LIST		
	M.D.	t	p Value	M.D.	t	p Value
High M.A.S.	+1.37	.34	n.s.	+5.93	.44	n.s.
Middle M.A.S.	+1.54	.58	n.s.	+1.75	.15	n.s.
Low M.A.S.	+1.94	.43	n.s.	-4.44	.41	n.s.
3 M.A.S. Groups Combined	+1.75	.75	n.s.	+1.08	.02	n.s.

+ = drug facilitates
- = drug impairs

APPENDIX Va

Digit Letter Coding Test Performance

Number Wrong

CONDITION	SIMPLE CODING		DIFFICULT CODING	
No-Drug	MEAN	S.D.	MEAN	S.D.
High M.A.S.	2.75	2.54	5.75	6.32
Middle M.A.S.	4.19	3.63	5.81	5.63
Low M.A.S.	4.44	3.71	4.69	5.07
Drug				
High M.A.S.	4.13	2.62	5.69	4.92
Middle M.A.S.	3.69	2.25	5.63	3.94
Low M.A.S.	3.06	2.30	3.44	2.55
No-Drug Plus Drug				
High M.A.S.	3.44	2.67	5.72	5.66
Middle M.A.S.	3.94	3.03	5.72	4.86
Low M.A.S.	3.75	3.16	4.06	4.06
3 M.A.S. Groups Combined				
No-Drug	3.79	3.42	5.42	4.88
Drug	3.63	2.44	4.92	4.07

APPENDIX Vb

Digit Letter Coding Performance for High, Middle and Low M.A.S. Subjects Under the No-Drug Condition

Number Wrong

SIMPLE CODING TEST

CONDITION	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	1.69	1.46	n.s.
High M.A.S. vs. Middle M.A.S.	1.44	1.26	n.s.
Middle M.A.S. vs. Low M.A.S.	.25	.19	n.s.

DIFFICULT CODING TEST

	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	1.06	.50	n.s.
High M.A.S. vs. Middle M.A.S.	.06	.03	n.s.
Middle M.A.S. vs. Low M.A.S.	1.12	.57	n.s.

APPENDIX Vc

Digit Letter Coding Test Performance for High, Middle and Low M.A.S. Subjects Under the Drug Condition

Number Wrong

SIMPLE CODING TEST

CONDITION	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	1.07	1.19	n.s.
High M.A.S. vs. Middle M.A.S.	.44	.49	n.s.
Middle M.A.S. vs. Low M.A.S.	.63	.76	n.s.

DIFFICULT CODING TEST

	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	2.25	1.57	n.s.
High M.A.S. vs. Middle M.A.S.	.06	.04	n.s.
Middle M.A.S. vs. Low M.A.S.	2.19	1.81	.10

APPENDIX Vd

Digit Letter Coding Test Performance
for High, Middle and Low M.A.S. Subjects Under the
Combined Drug and No-Drug Conditions

Number Wrong

SIMPLE CODING TEST

CONDITION	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	.31	.41	n.s.
High M.A.S. vs. Middle M.A.S.	.50	.69	n.s.
Middle M.A.S. vs. Low M.A.S.	.19	.24	n.s.

DIFFICULT CODING TEST

	Mean Difference	t	p Value
High M.A.S. vs. Low M.A.S.	1.66	1.30	n.s.
High M.A.S. vs. Middle M.A.S.	--	--	--
Middle M.A.S. vs. Low M.A.S.	1.66	1.45	n.s.

APPENDIX Ve

Digit Letter Coding Test Performance for High, Middle and Low M.A.S. Subjects and for All Three Groups Combined Under Drug and No-Drug Conditions

Number Wrong

CONDITION	SIMPLE ERRORS			DIFFICULT ERRORS		
	M.D.	t	p Value	M.D.	t	p Value
High M.A.S.	-1.38	1.50	n.s.	+ .06	.03	n.s.
Middle M.A.S.	+ .50	.45	n.s.	+ .18	.10	n.s.
Low M.A.S.	+1.38	1.22	n.s.	+1.25	.85	n.s.
Drug vs. No-Drug	+ .16	.27	n.s.	+ .50	.50	n.s.

+ = drug facilitates
- = drug impairs

APPENDIX VIa

Before being presented with the first paired-associates list, a subject was given the following instructions:

"In this experiment you will memorize pairs of adjectives. At no time during the experiment will you receive shock or any other unusual stimulation.

"It is very important that you follow all the instructions given to you to the best of your ability, and that you do not discuss the experiment with anyone else.

"I am going to present to you by means of this mechanically controlled exposure device (experimenter points), a number of pairs of words. You should give your undivided attention to each unit as it appears in the lighted aperture. It is essential that you give your undivided attention to the words presented, for otherwise the purpose of this mechanically controlled exposure device will be defeated. After we have been through all the pairs once, there will be a short rest and then we will go through the pairs again.

"First a word will appear on the left hand side of the window. After a short exposure of this word alone, the shutter will drop and you will see here, on the right, another word. Your task is to learn, whenever the first word appears, to call out the second word before the shutter drops. After showing you a pair of words, the drum will turn, and another word will appear on the left; the shutter will then drop to show you the second word of this pair, and so on. When a given word appears in the window, always try to call out the word that is paired with it.

"Disregard the order in which the pairs of words appear in the window; they will appear in the window together. You will be through with this part of the experiment when you call out correctly the second word of every pair on two successive presentations of the entire list.

"If you miss a word you thought you had learned, or if you call out a wrong word, do not be disturbed by this. As soon as the next word appears on the left, try to call out the second member of the new pair.

"Certain special instructions should be followed explicitly if this experiment is to have any value for us:

1) Always call out the word which you think is under the shutter. Do this on every trial for every key word, attempting to get as many correct anticipations as you can all the time.
2) Always try to anticipate the hidden word as quickly as you can before the shutter drops.
3) Always check the accuracy of your attempted anticipation by looking at the word that is revealed when the shutter drops. After calling out a word, watch to see if you have called out the correct word. If you are unable to call out the word, watch to see what the correct word is when the shutter drops.
4) Do not let your attention wander to other words in the series. Concentrate on the words which are in the window at the time. As soon as the drum turns, regardless of what you have done with the preceding pair, concentrate on calling out the next response.
5) The most important thing for you to do is to try to anticipate as many of the words as possible every time, and to call out your response as quickly as you can after the key word appears on the left."

Before the second paired-associates list the subject was given the following instructions: I am going to present now some different pairs of words which you are to learn in the same way as you did the first ones. You will go on learning until you have satisfied a degree of perfection which we have set.[7]

APPENDIX VIb

Before the first two-minute trial on the pursuit rotor, each subject was given the following instructions: "This is a test of your ability to follow a moving target. This black disc (experimenter points) will rotate in a clockwise direction (experimenter traces with finger). Your task is to keep the point of this stylus (experimenter points) in contact with the round brass target (experimenter points) while the disc is turning. Your score is the amount of time the stylus is on the target.

"The stylus is to be held lightly in your preferred hand in this manner (experimenter shows subject). Hold the back of the hand up, with all your fingers and the thumb grasping the handle. (Experimenter follows moving target with stylus). Follow the target like this, trying to stay in contact with it for as great a time as possible. You will do best if you develop a smooth free-swinging motion of your arm, shoulder and body, like this (experimenter demonstrates).

"You will notice that the stylus is made so that you cannot easily put pressure on its point. Do not attempt to put pressure on the stylus like this (experimenter demonstrates), or by putting your finger on the metal rod, like this (experimenter demonstrates). Now pick up your stylus and place it on the target. (At this point, experimenter examined subject's grip, and corrected it if necessary by repeating appropriate parts of the instructions).

"When the disc starts, put the stylus on the target and try to keep it there. Your score does not begin to record until I say go. When the disc stops, lift the stylus off the target and keep it off. Are there any questions?"

Prior to the second, third, fourth, and fifth trials the subject was told: "You are now going to have another trial on the pursuit rotor. Your task is to try to keep the point of the stylus in contact with the target for as much of the time as you can."

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ABSTRACT

The present study focused specifically on the following experimental issues:

1) The nature of the relationship between M.A.S. score and performance on a variety of simple and complex tasks performed by the same subjects.

2) The extent to which amphetamine alone affects performance of these same tasks.

3) The nature of inter-relationships between the following variables: a) type of learning material, b) drug, c) M.A.S. score.

4) The nature of the combined effects of two drives on the performance of the various tasks.

Method and Procedure

Subjects: 96 male undergraduate students were assigned to either high, middle or low M.A.S. groups on the basis of their scores on the Taylor Manifest Anxiety Scale. Half of the subjects in each of the three M.A.S. groups received amphetamine, (14 mg/70 kg of body weight), which was taken orally two hours prior to the experimental session. The other half received visually identical placebo capsules also taken two hours prior to reporting for the experimental session.

Materials: Two paired-associates lists. The non-competitive list consisted of fifteen pairs of adjectives of high associative connection and low intra-list similarity. The competitive list consisted of twelve pairs of adjectives.

Two digit-letter coding tests: a simple test and a difficult test.

Pursuit rotor: revolving at 33 r.p.m. Each subject had five 2 minute trials on the pursuit rotor.

Experimental Design: Eight orders of task presentation were employed. The use of eight test orders made the examination for interactions between order of task presentation, M.A.S. level, and drug possible. No significant interactions were found between order of task administration and either M.A.S. level or drug.

Overall Results

The overall findings for the effect of M.A.S. alone are as follows: 1) The Spence-Taylor differential hypothesis that high M.A.S. subjects would be superior on the simple list and that low M.A.S. subjects would be superior on the difficult list was confirmed. 2) M.A.S. level did not have a statistically significant effect on the performance of the two digit-letter coding tests, although there were tendencies for the high M.A.S. group to be superior on the simple test and for the low M.A.S. group to be superior on the difficult test. 3) M.A.S. level did not affect performance on the pursuit rotor. 4) The performance of middle M.A.S. subjects fell closest to that of the low M.A.S. group on paired-associates learning, and digit-letter coding performance, but was closer to that of the high M.A.S. group on the pursuit rotor.

When examining the independent effects of the drug: 1) The drug, amphetamine, facilitated, ($p=.05$), learning on the simple paired-associates list, and 2) performance, ($p=.01$), on the simple digit-letter coding test, but had no effect on the difficult versions of these two tasks. 3) Amphetamine significantly, ($p=.05$), facilitated performance on the pursuit rotor, and this effect became more marked, ($p=.001$), with increased trials on the rotor.

The results relating to the combined effects of drug and M.A.S. level, while not statistically significant, showed the following trends: The drug amphetamine facilitated learning for all M.A.S. groups on the simple paired-associates list. The greatest degree of facilitation due to the drug was noted in the performance of the low M.A.S. group. The drug facilitated the performance of all three M.A.S. groups on the simple digit-letter coding test, but had its most marked effect on the performance of the low M.A.S. group.

General Conclusions and Discussion

1) The present study confirmed the results of previous investigators using independent samples on paired-associates tasks. 2) Furthermore, the results of the present study are in agreement with the small number of previous studies employing a middle M.A.S. group in demonstrating that the Taylor Scale yields a dichotomous measure rather than a continuous scale. 3) Amphetamine had statistically significant effects on all three tasks. M.A.S. level, on the other hand, was significantly related only to performance on both paired-associates lists, showed some tendency in the direction of influencing performance on the digit-letter coding tests, and had no effect on pursuit rotor performance. In the present study then, the drug amphetamine was more successful than M.A.S. level in affecting performance on a wide variety of tasks.

M.A.S. level significantly affected performance only when the relative associative strengths of task-relevant and task-irrelevant tendencies were controlled and manipulated, that is, in paired-associates learning.

VITA CURRICULUM

I was born in Paterson, New Jersey, September 27, 1935 to Ida D. and Leon Weitzner.

I attended public school, Junior High and Lafayette High School in Brooklyn, New York.

I attended New York University from September 1952 to June 1956 when I received the A.B. degree.

In 1957 I matriculated as a full-time candidate for the A.M. degree in Psychology at Boston University. I obtained this degree in 1958. Since then I have continued graduate study toward the Ph.D degree in the area of Experimental Psychology.

During the period from September 1958 to June 1960 I was a Teaching Fellow in the Department of Psychology at Boston University.

During the period from September 1960 to June 1962 I was a Research Technician in the Department of Psychology at M.I.T.

Since May of 1961 I have been working at the Massachusetts General Hospital, as a Research Psychologist in the Department of Anesthesia. My work here has focused primarily on the effects of drugs upon behavior utilizing both subjective and objective criteria, learning models, etc.

I am a member of the American Association for the Advancement of Science and have had published: "Increased Sensitivity of Measurement of Drug Effects in Expert Swimmers", J. of Pharmacology and Experimental Therapeutics, 1963, 139, 114.

I also have in press: "The Effects of Amphetamine and Secobarbital on Mathematical and Coding Performance", J. of Pharmacology and Experimental Therapeutics, 1963. Both publications were co-authored with G.M. Smith and H.K. Beecher.