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A Psychopharmacological Approach to the Study of Perceptual Behavior

Mary Kay Snyder
Loyola University Chicago

A PSYCHOPHARMACOLOGICAL APPROACH TO THE STUDY OF PERCEPTUAL BEHAVIOR

by

Mary Kay Snyder

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LIFE

Mary Kay Snyder was born in Chicago, Illinois, on November 22, 1932. She was graduated from Mundelein College where she received the degree of Bachelor of Arts in June, 1954. From September, 1954, until September, 1959, she was employed by the Chicago Tribune as a Research Assistant in the Market Research Department. In September, 1959, she began graduate studies in psychology at Loyola University on a National Defense Education Act Fellowship. From June, 1962, to June, 1963, she was employed as a Research Assistant in the Loyola Behavior Laboratory. From June, 1963, until the present time, she has been employed as a Research Associate in the Loyola Psychometric Laboratory. She was a part-time instructor in the Psychology Department of Mundelein College from February, 1961 until June, 1965.

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PROBLEM

Within the past two decades, one area of psychological research which has undergone tremendous growth is the investigation of drug effects. The introduction of the new drugs in the 1950's, which were quickly hailed as the answer to many of man's problems, led to an enormous amount of research on several levels and within many disciplines. Because of the large volume of drug studies performed in recent years, one might be tempted to claim that more research on the subject is not necessary. However, when one investigates a little deeper into the area of drug research, he notes that there is a great need for some answers to some fairly pertinent problems. For example, the great bulk of studies seeking to determine the behavioral effects of drugs employ either animals or clinical patients as subjects. There is no doubt that the primary purpose of drug research is to objectively and scientifically determine the effects of pharmacological agents upon human behavior and experience. However, it seems to this experimenter, that when it comes to assessing drug effects on psychological phenomena, the value of animal studies is somewhat questionable. Of course, in the early stages of research on a particular drug, there can be no question as to the importance of experiments using animals as subjects.

But when the research has progressed to the level of questioning the drug's effects on learning, retention, perception, etc., it would seem that generalizations from animal behavior to human behavior must necessarily be rather cautious.

By the same token, it would seem that one would first want to know how a given drug affects performance in a normal person before determining its effects on those who deviate from the normal. This procedure, first studying the normal, and then the abnormal, seems to be quite standard in practically all other areas of study, with the exception of drug research. It is possible that a lack of knowledge regarding the behavior of normals may lead to quite false impressions of a given drug's effects. For example, a researcher finds that a certain drug does not have any effect on schizophrenics' ability to perform a particular task. Consequently, he concludes that this drug does not have any effect on this ability; however, it may be that this ability in normals is affected quite seriously. Therefore, the drug does have some effect on this ability, such that in schizophrenics, the ability is not impaired, while in normals, it is. While this example is admittedly an oversimplification, it does highlight the importance of first knowing the effects of a drug on normal behavior. Furthermore, many of the chemicals currently undergoing investigation are already being administered therapeutically to persons who <u>are</u> normal, at least to the extent that they are not hospitalized, or who deviate from the normal in only a minor way.

With these points in mind, it is now possible to discuss the subject of the present study which was undertaken to investigate the effects of four pharmacological agents upon the perceptual behavior of normal human adults. A large number of studies have been conducted in which only a single perceptual phenomenon has been selected to determine if a given pharmacological agent has any effect upon it. The use of a single measure certainly limits the amount of information determined about the agent's effect on perception. The present study selected a rather comprehensive range of perceptual phenomena for investigation.

The selection of the material used in this study was determined to a certain extent by the methodological approach employed. It was felt that the factor analytic method lends itself particularly effectively to the investigation of effects of drugs on human performance. The use of a single test and measuring performance before and after administration of a drug, may show no difference between the two scores. Yet, is it possible that the real effects of the drugs are obscured when a single total score is taken as the measure of performance. Performance in one ability involved in the total score may be enhanced by the drug and performance in another ability may be correspondingly decreased. In this instance, the total score would remain the same and the conclusion

drawn that the drug had no effect, when in reality, this was not the case. The factor analytic approach to the study of drug effects makes it possible to detect changes in performance which would not be apparent using other methods of analysis. Trouton & Eysenck (1961) believe that ".... the only approach to drug studies which can give us psychologically meaningful information is the factorial or dimensional approach" (p.639). They even go so far as to suggest that all previous drug research is only suggestive and conclusions based on it, can be at best, only tentative.

In his studies of the Primary Mental Abilities (1938) Thurstone discovered a factor which he named the Perceptual Factor. The nature of this factor as well as its relation to other abilities led Thurstone to undertake a systematic investigation of perception from a factorial viewpoint (1944). Using a battery consisting of 60 tests, he found eight perceptual factors. The present study selected for investigation five of these factors and the tests which identified them. These factors are: perceptual closure, flexibility of closure, speed of perceptual closure, rate of alternation, and perceptual illusions. These factors were chosen because it was felt that they represented perceptual phenomena which might be susceptible to the actions of the drugs. It was hypothesized that in a drug-free situation, these factors would provide a clear factorial structure of perception which could then be

compared with the factorial structures obtained when the subjects were under the influence of certain basic pharmacological agents.

The agents used in this study were selected on the basis of the anatomical locus of their activity in the nervous system. Two cholinergic and two adrenergic drugs were chosen for investigation. The two cholinergic drugs were atropine sulfate (a cholinergic blocker) and physostigmine salicylate (a cholinergic stimulant); the two adrenergic drugs were chlorpromazine hydrochloride (an adrenergic blocker) and dexedrine (an adrenergic stimulant). Functionally, these agents may be classified as two stimulants (atropine sulfate and dexedrine) and two depressants (physostigmine salicylate and chlorpromazine).

A brief description of the nature and function of each of these four agents is necessary in order to be able to interpret and evaluate their effects. The following information is taken from two current textbooks of pharmacology (Goodman, 1965; Musser & Bird, 1962).

Atropine Sulfate is a cholinergic blocking agent, depressing the action of the parasympathetic nervous system. It inhibits the actions of acetylcholine on those structures innervated by postganglionic cholinergic nerves and on smooth muscles that respond to acetylcholine but lack cholinergic innervation. The average clinical adult dose is between 0.5 and 1.0 mg. With a low dose, there is central nervous

system stimulation, the medulla and also higher cerebral centers being stimulated. The typical effects of a 0.5 mg dose are a slight cardiac slowing, some dryness of the mouth, inhibition of sweating, mild dilation of the pupil, and inhibition of accomodation of the eye. With larger doses, the above effects are accentuated except that there is then acceleration of the heart rate.

Physostigmine salicylate (also called eserine) is a cholinergic stimulant, enhancing the action of the parasympathetic nervous system. An anticholinesterase, it inactivates the acetylcholinesterase which terminates the transmitter action of acetylcholine at the junction of the various cholinergic nerve endings. By causing acetylcholine to accumulate at the nerve endings, the result is continuous stimulation of cholinergic fibers. As a group, anticholinesterases are better known for their toxic qualities; namely, for use as insecticides as well as in the area of chemical warfare (the so-called "nerve gas" is an anticholinesterase). Nevertheless, some do have therapeutic applications, such as in the treatment of glaucoma and myasthenia gravis. The main effects of a low dose of physostigmine are constriction of the pupil, spasm of accomodation, enhancement of gastric contractions, increased secretion of acid gastric juice, and increased glandular secretions.

Chlorpromazine hydrochloride, an adrenergic blocking agent, depresses the action of the sympathetic nervous system. It depresses the reticular formation as well as the diffuse thalamic projection system, thereby diminishing alertness. It acts on the hypothalamus which is partially responsible for the vasodilation of the blood vessels and lowering of the blood pressure. This action on the hypothalamus also causes a lowering of body temperature and the basal metabolic rate. The usual dosage is 25 mg four times a day or 10 mg to 1 Gm daily.

Dexedrine sulfate is a stimulant of the sympathetic nervous system, having primary action in the cerebral cortex. It has little or no action on the peripheral nervous system and therefore, does not affect blood pressure. The usual clinical dose is 5 mg twice a day.

Being aware of the nature and characteristics of the pharmacological agents which were used in this study, it would be of interest now to examine in more detail the material used to test the effects of these agents. As mentioned previously, tests representing five perceptual factors found by Thurstone were included for study. According to Thurstone, the factor termed "perceptual closure" represents an ability to form a perceptual closure against some distraction. The subject must be able to form closure out of material which has an unorganized presentation. Using material identical or similar to that used by

Thurstone, the existence of this factor has been verified by several other experimenters (Baer, 1964; Botzum, 1951; Mooney, 1954; Roff, 1952). The factor of flexibility of closure is concerned with the manipulation of two configurations which the subject must deal with simultaneously or successively. The subject's ability to do well in the tests which identify this factor depends on his flexibility in manipulating several more or less irrelevant or conflicting gestalts. This factor has also been identified by experimenters employing the same type of material as did Thurstone (Baer, 1964; Botzum, 1951; Roff, 1952). Using different tests, Rimoldi (1948) extracted a factor which he described as being very similar to this factor of Thurstone's. From his battery of 70 tests, Roff (1952) also extracted a factor which he termed "objectivity of perception." The tests identifying this factor were all illusions involving geometric designs. There is little doubt that this factor is identical to Thurstone's "perceptual illusions" factor. The factor of rate of alternation was verified by Baer (1964) who included one test identical to one used by Thurstone and one very similar to it.

In spite of the fact that most of the studies in the literature deal with drug effects on only a few perceptual tests, it might be appropriate here to mention some of those which pertain directly to the present study. The amphetamines (of which dexedrine is one) seem to be the most commonly used agents in studies dealing with perception and normal subjects. Studies utilizing atropine sulfate or physostigmine and normal subjects

are particularly meager; the effect of chlorpromazine on the perception of clinical patients rather than normals seems to be the rule with the majority of studies.

Performance in tests of perceptual speed is enhanced when normal subjects have been administered amphetamine (Carl & Turner, 1939; Kleemeier & Kleemeier, 1947). Nash (1962) used three tests which also appeared in the present battery: mutilated words, Gestalt completion, and concealed figures. He found that subjects who had taken dexedrine had a significantly better performance on the Gestalt completion test but no change occurred on the other two tests. This is interesting because both the Gestalt completion test and the mutilated words test have been found to be highly loaded in the same factor. One would expect that dexedrine would effect performance in both of these tests in the same way, and yet it appeared that only one of the tests was affected.

Other researchers (Carl & Turner, 1939; Lehman & Csank, 1957) have found that amphetamine improves performance on digits forward but causes little change in the digits backwards test (the latter is included in the present battery). Agnew (1962) discovered that a greater number of figure reversals occur under amphetamine than under a placebo. Other studies which have a direct bearing on the interpretation of the results obtained in the present investigation will be mentioned later in the appropriate section.

In conclusion, it may be stated that the specific aim of this investigation was to determine what perceptual changes, if any, occur when a person is under the influence of certain pharmacological agents. Furthermore, three secondary hypotheses were formulated:

1) The factorial structures obtained from the no-capsule and placebo conditions would be similar to each other as well as to Thurstone's structure.
2) The factorial structures obtained from the two conditions in whibh a stimulant was used (atropine and dexedrine) would be similar to each other.
3) The factorial structures obtained from the two conditions in which a depressant was used (physostigmine and chlorpromazine) would be similar to each other.

METHOD

Subjects

A total of twenty subjects, ten male and ten female, were studied. They were between the ages of 21 and 31 and had no history of psychiatric and/or clinical disturbances. The minimum educational level was senior year in college. Before being accepted as a subject, each person who volunteered to participate in the study underwent a physical examination by a physician. This was done in order to preclude the possibility of any untoward effects of the pharmacological agents due to some physical condition on the part of the subject. For acting as a subject in this research as well as other testing which was done during the same sessions, each person was remunerated at the completion of the testing. This research was part of a larger project supported by the Psychiatric Training and Research Authority of the State of Illinois.

Instruments

A rather complete description of each test used in the battery is given below. Where appropriate, an example of certain tests appears in the Appendix (Figure 1). The number of each test remains constant throughout the paper and also reflects the order in which the tests were administered. Tests 1 through 13 are essentially the same tests used by Thurstone in his factorial study of perception (1944). The form, administration, and scoring of these tests were taken directly from his study.

In as much as the design of this experiment required that each test in the battery be administered six times to every subject, it was necessary to adapt some of the tests (Tests 1, 2, 3, 9 and 10). It was felt that if the same items making up these tests were presented six times, many effects due to the drugs might be obscured, in spite of the counterbalancing design. Therefore, it was decided to create six parallel forms of these tests by selecting all of the items used by Thurstone and assigning them to the various forms in such a way that each form contained the same number of easy and difficult items. Because this procedure shortened the tests, some new items were constructed by the experimenter. Every effort was made to create items which were similar in content and difficulty to Thurstone's. The items were then tested as to their difficulty by administering them individually to a small number of subjects and recording the time required to arrive at the correct answer. On the basis of this index of difficulty, the items were assigned to the six forms.

It should be noted that even with the addition of these new items, with the exception of Test 2, the majority of the items making up the tests are taken from Thurstone, only one or two new items being included in each form. In the case of Test 2, even though most of the items are newly constructed, the nature of the test is such that it was not a difficult matter to devise items similar to those used by Thurstone. Therefore, it was felt that the addition of these new items would not affect the factorial identity of the tests.

Tests 14 and 15, while not used by Thurstone, were included because they have been found to be highly loaded in one of the factors under investigation in this study (Rimoldi, 1948).

Test 1. Street Gestalt Completion. Each of the six forms of this test contains six items. Each item consisted of a drawing of a familiar object in which parts were missing. In adapting the test for this experiment a photograph was made of each picture. The slides were projected on a white wall about 15 feet in front of the subject, and the average height of the pictures was about ten inches. The subject was seated at a table in front of a tape recorder. A sample picture was always projected first, and the experimenter said: "In this test you will be asked to name into the microphone as quickly as you can the objects shown on the screen. That is a sailboat on the screen now. Not all of the projections will be so clear as this one. Many will have more parts missing. You are allowed to guess as many times as you wish in this test, but always guess into the microphone. Wrong guesses will not count against you. The test begins on the next frame." The maximum time the slide was presented was thirty seconds. The experimenter kept a record of all of the subject's answers as well as the response time for each answer. The score for this test was the total number of items to which a correct response was given in three seconds or less after each presentation.

Test 2. Mutilated Words. This test is very similar to the one described above except that each item consists of a word in which parts of the letters have been blocked out or erased. Each form of the test consisted of one practice word plus twelve test words. The material was presented in the same fashion as Test 1. The instructions were: "On each frame you will see a word. Parts of the word have been erased. See how quickly you can pronounce it." (The practice word was then projected). "All the words used in this test are ordinary words and were originally made from lower case letters. The test begins on the next frame. Pronounce each word as promptly as you can into the microphone. Do not hesitate to guess." The exposure time was thirty seconds and a record was kept of all answers and their times. The score was the total number of items to which a correct response was given in three seconds or less after each presentation.

Test 3. Dotted Outlines. Each of the four test items consisted of several dots which represented either a capital letter or a number. The presentation of this test was identical to Tests 1 and 2. A practice item was first projected and the instructions were: "In this test you will be shown a number of dots as shown by the example on the screen. You are to use all of the dots shown in making either a capital letter or a single digit. Just as soon as you recognize the figure on the screen, you are to pronounce it into the microphone. You are allowed

to guess as many times as you wish. Wrong guesses will not count against you. The test begins on the next frame." Each item was presented thirty seconds and a record was kept of all answers and their times. The score was the total number of items to which a correct response was given in three seconds or less after each presentation.

Test 4. Necker Cube. The drawing of the Necker Cube was made on white cardboard 17 by 22 inches. The sides of the large squares measured 8 inches and a fixation point was provided in the middle of the drawing. The figure was mounted about 15 feet in front of the subject at a height slightly above his eyes. The experimenter asked the subject to concentrate his attention on the dot in the center and to describe what he saw. If he did not experience the change in spatial relations, he was encouraged to discover the two perspectives. After he reported that he had seen the shift in the cube he was told to rest his eyes for a minute. He was then given a manual counter and the following instructions: "Continue looking at the figure and press the counter every time there is a change in phase or perspective. Just take a passive attitude. Don't force these changes - just allow them to come naturally." Two exposures of one minute each were used, with a one minute rest period between the two exposures. The timing was begun at the first change. The score was the total number of alternations during the two minutes.

Test 5. Schroder Stair Figure. The figure of the staircase was drawn on white cardboard 25 by 33 inches. The height of the staircase was 8½ inches and it was 10 inches long. A fixation point was provided in the center of the drawing. Both the instructions and the scoring for this test were the same as for the Necker Cube.

Test 6. Sanders Parallelogram. This test was one of the three illusions used in the battery. There were fifteen different drawings of the figure, each one on a separate card measuring 7 by 10½ inches. Each of the fifteen drawings was represented twice in the cards that were shown to the subject. The thirty cards were presented in random order and the subject was instructed to tell whether the diagonal line on the right was longer or shorter than the diagonal line on the left. The score was the number of times the subject reported that the right diagonal was longer. A low score represented a high amount of illusion.

Test 7. Poggendorf Illusion. There were twenty-three different drawings of this illusion, each on a card measuring 7 by 11 inches. The cards were presented to the subject in random order and he was asked to report whether the line on the right was too high or too low.if it is regarded as a continuation of the left-hand line. The score was the number of times the subject said that the right-hand line was too high. For this test, a high score represented a high amount of illusion.

Test 8. Muller-Lyer Illusion. Ten different figures, each used twice, were drawn on cards measuring 7 by 10½ inches. The twenty cards were presented in random order. The length of the horizontal line of each figure was standard and the position of the middle arrow was varied. For each presentation the subject was asked to tell whether the right-hand section was longer or shorter than the left-hand section. The score was the number of times the right-hand section was reported as being longer. A low score represented a high amount of illusion.

Test 9. Gottschaldt A. In this test a simple figure and a complex figure were presented to the subject. The task was to find the simple figure embedded in the more complex one and then mark it. There were six items in each test. The subject was given a set of instructions and two sample problems. After it had been determined that he understood the instructions, he was told to begin the test proper. The score was the total number of items successfully completed within 75 seconds.

Test 10. Gottschaldt B. The task in this test is essentially the same as in Test 9, except that both the figures and the directions are more complex and therefore, the test is believed to be more difficult. There are two parts to the test. In the first part, the subject is presented with a simple figure which he is to find embedded in both of the two adjacent complex figures. In the second part, he is shown two simple

figures.. Next to these are two complex figures, each of which contains one of the simple figures. The subject must determine which of the simple figures is contained in each of the complex ones and then outline it. Again, sample problems were first administered to insure that the subject understood the task. Each test consisted of eight items. The score was the total number successfully completed within 105 seconds.

Test 11. Retinal Rivalry Reversals. An ordinary stereoscope, with a blue field for the left eye and a yellow field for the right eye, was used for this test. The subject was instructed to discover the fluctuating color dominance. He was then given a rest period of one minute. The hand counter was then given to him with the following instructions: "Hold the stereoscope steady and press the counter each time you experience a change in color dominance. Just take a passive attitude. Don't force these changes; just allow them to come naturally." Two exposures of one minute each were given with a one minute rest period between them. The timing was begun at the first change. The score was the total number of alternations during the two minutes.

Test 12. Shape Constancy. For this test the subject was seated behind a vertical screen with a 3/4 by 5½ inch slit in it. Off to the subject's side was a large cardboard on which were drawn 16 numbered diamonds. They were ordered in the vertical dimension from a six inch square (#1) down to a diamond whose height was only ½ inch (#16). Through

the slit in the screen the subject was shown a 4 inch square cardboard. It was first presented in a vertical diamond position and then it was held horizontally, while the experimenter pointed out that in the latter position, it looked like a straight line. The card was then placed on a table so that the corners of the diamond faced the subject. While looking at the card through the screen, the subject was told, "Now the card looks like a diamond somewhere between a square and a straight line. Look at the board to your side and tell me the number of the particular diamond which most nearly resembles the apparent shape of the cardboard." The score was simply the number of the diamond selected by the subject.

Test 13. Hidden Pictures. A large picture which contained several hidden familiar objects within it was used for this test.* The subject was first presented with a sample picture and a list of the objects hidden within it. He then pointed out to the experimenter where these objects were hidden. He was then told, "I am going to give you another picture and a list of the objects which are hidden somewhere in it. Find them as rapidly as you can and show me each time you find another." The score was the total time it took the subject to find the first seven of the eight hidden pictures.

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* The pictures for this test were taken from Child Life Magazine.

Test 14. Cancellation of Figures. The subject was presented with a piece of paper at the top of which was drawn a small square with a perpendicular line extending from the middle of one side to the middle of the square. The printed instructions were, "Some of the squares in the following rows have the line in the same position as in the example. You are to draw a line through those figures which are the same as the example." The score was the total number of correct squares minus the incorrect ones completed within thirty seconds.

Test 15. Digits Backward. The experimenter read a list of numbers which the subject was to repeat in reverse order. The list consisted of two sets of from three to nine digits. If the subject failed to repeat the correct numbers, he was given a second opportunity to reverse an alternate series consisting of the same number of digits. There were no time limits. The score was the highest number of digits correctly reversed.

Tests 16, 17 and 18. Each of the first three tests were scored in a second manner. Tests 16, 17 and 18 represent this additional scoring method (Test 16 corresponds to Test 1, 17 to 2, and 18 to 3). The score here reflects the total time for the subject to respond to each item. If an incorrect response was given initially and then corrected within the time limit, the time for the correct response was taken. If an incorrect response was given to an item or if no response was given, then a score of 30 (for the 30 second time limit) was recorded.

Drugs

The dose of each of the pharmacological agents used in this study are as follows:*

1. Atropine Sulfate -- .5 mg
2. Physostigmine salicylate -- 2 mg
3. Chlorpromazine hydrochloride -- 50 mg
4. Dexedrine -- 5 mg

These levels were selected because they represent the average clinical dose and therefore, dramatic or extensive overt behavioral changes were eliminated. Both the drugs and the placebo were in capsule form and had the same external appearance.

Each agent was administered one hour before the commencement of testing and each session lasted no longer than five hours. This was done to insure that all of the testing would be accomplished while the subjects were under the maximum influence of the drug. A period of at least four days elapsed between sessions so that all direct and indirect physiological effects of the pharmacological agents were absent when the next drug was administered.

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* The experimenter is indebted to Peter Talso, M.D., Internist and Chairman of the Department of Medicine, and Alexander Karczmar, Ph.D., Chairman of the Department of Pharmacology, both of the Stritch School of Medicine who acted as consultants for this study. They offered advice both as to the optimum dose to employ as well as to the duration of the drugs' actions.

Facilities

All of the testing was conducted at the facilities of the Department of Medicine, Stritch School of Medicine, Hines, Illinois. The purpose of this was so that it was possible for a medical doctor to be on the premises for the entire duration of the testing session.

Procedure

For each subject there was a total of six testing sessions, one for each of the four drugs, a placebo condition, and a normal (no capsule administered) condition. One battery consisting of fifteen tests was administered during each session. Since there were six conditions, and hence six forms of the battery, the order of presentation of both the conditions and the forms was presented in a systematic randomized fashion. That is, each condition was presented approximately three times in the first session, three times second, three times third, and so on, through all six possible orders. In the same manner, each form of the battery was presented approximately three times in the first session, three times second, three times third and so on. Since there were twenty subjects and six conditions and six batteries, it was necessary for two conditions and two batteries to appear four times in the first order, for two to appear four times in the second order, etc. The net result was that each condition and each battery was presented approximately the same number of times in the various orders. This design was necessary to prevent the obscuring of the effects

due to the drugs, by the effects of practice and learning.

The administration of the capsules was done in a double blind fashion, neither the experimenter nor the subject knowing what the capsule contained. Before the testing was begun, the subjects were told only that the capsules contained pharmacological agents which are medically safe, have undergone extensive research, and no serious or permanent side effects would be experienced. At the conclusion of all the testing of all subjects, the identity of the agents was told to those subjects who wished to know what drugs had been employed.

RESULTS

After the entire testing had been completed, all of the data was organized according to condition. The intercorrelations of the eighteen measures were performed for each condition by means of an I.B.M. 7094 computer.

For ease in the interpretation of the results, it was desired that each score represent measurement in the same direction as well as provide the same unit of measurement. Therefore, before proceeding further, it was necessary to reverse the sign of some tests in the correlation matrices. Low scores on two of the illusions, the Sanders and the Muller-Lyer, reflect a high amount of illusion. However, a low score on the Poggendorf illusion reflects a low amount of illusion. Therefore, in order to make a low score mean the same thing in all of the illusions, the sign of the Poggendorf illusion (Test 7) was reversed. Furthermore, with the exception of Hidden Pictures and the additional scoring method represented by Tests 16, 17, and 18, all of the tests were scored in terms of unit of performance per unit of time. Again, so that all of the scores reflect the same unit of measurement, the signs of Tests 13, 16, 17 and 18 were also reversed.

After this had been accomplished, the I.B.M. 7094 computer was again utilized to factor analyze each of the six conditions according to the principal axes solution. The problem of estimating the communalities was handled in the following manner. A factor analysis of each of the six

conditions was first performed using unity in the diagonals. Therefore, the factor solutions included not only common factors but also specific and error factors. Each of the solutions was then inspected to determine the number of common factors. A decision as to their number was made on the basis of three criteria: 1) the value of the eigen value associated with a given factor; 2) the percentage of variance extracted; 3) an inspection of the factor loadings with a view toward reproducing the correlation matrix. Having decided upon the number of common factors for each problem, the communalities were then computed. It was determined that these values agreed very closely with a communality estimate based on the highest correlation in a column, as suggested by Thurstone (1960). Therefore, the six factor analyses were then computed by using the maximum correlation in the diagonal. The computer was programmed to continue factoring until all of the variance had been extracted. The residual matrices were examined and it was found that the communality estimates and the factor solutions agreed with the original data as represented in the matrices of correlation.

For the purpose of psychological interpretation, it was then necessary to rotate each orthogonal solution to the criterion of simple structure. Oblique hand graphical rotations were then taken for each condition until the closest possible approximation to simple structure had been obtained. At the completion of the graphical rotations, an

I.B.M. 7094 computer was utilized to rotate each of the factor solutions using the varimax method of rotation. The structures were examined and compared with the graphical rotations and it was found that they were quite similar. However, it was determined that the latter more closely approached simple structure and therefore, it is the structures based on the oblique hand graphical rotations that will be reported in the following section.

Table 8 of the Appendix contains the values of the communalities for each of the tests in all six conditions. These are presented so that the reader may have some idea of the reliability of each of the tests. It should be noted that the communality is always less than the reliability of a test, and therefore, the true reliability of each test is higher than the given communality value. In other words, the values in Table 8 represent the lower limit of the reliabilities of the various tests.

A description and interpretation of the factor structures obtained in each of the six conditions will now be presented. In order to simplify the presentation of the results, only the factor loadings having an absolute value greater than .30 will be included in this section. Other relevant tables will be found in the Appendix. Tables 9 to 14 contain the intercorrelations of the eighteen measures for each of the six conditions. The unrotated principal axes solutions for the six conditions are in Tables 15 to 20. Tables 21 through 32 show the final transformation matrices and the corresponding cosine matrices for all conditions. The final ob-

lique rotated factor matrices for all conditions are presented in Tables 33 to 38. In all of the above cases, the order for each set of tables follows the presentation of the conditions.

Normal Condition

Six factors were extracted in this condition. Of the six factors, one was a doublet and one's interpretation is not clear. The letter designation used to identify the factors in this and the following conditions is purely arbitrary and in no way affects the interpretation of the structure or its comparison with the other structures.

Factor A

Tests		Loadings
4.	Necker Cube	.72
11.	Retinal Rivalry Reversals	.67
10.	Gottschaldt B	.64
5.	Schroder Stair Figure	.53
9.	Gottschaldt A	.49

The presence of the three tests involving perceptual reversals (Test 4, 11 and 5) clearly indicates that this factor represents the rate of alternations as also found by Thurstone (1944). What was unexpected, however, is the presence of the Gottschaldt Figures in this factor, both of which have considerable loadings. In Thurstone's study, these tests had negligible loadings in this factor. One possible explanation for their presence may be determined by examining what the person must do in order to score well on these tests. He must be able to shift his per-

spective of the various lines making up the complex figure in order to find the simple figure which is somewhere embedded in it. This shifting or altering of perspective is precisely what is measured in the other three tests. Therefore, it does not seem unlikely that a person who experiences a large number of reversals would also perform better on the Gottschaldt Figures tests. This hypothesis of a positive relationship between reversible perspective and embedded figures was recently tested (Newbiggins, 1964). It was found that persons who made fewer reversals took a longer period of time to find embedded figures while those who experienced a large number of reversals took a shorter period of time. The results of this experiment lend support to the interpretation of this factor.

Factor B

Tests	Loadings
16. Street Gestalt (time)	.60
1. Street Gestalt	.54
6. Sanders Illusion	-.40

This factor is bipolar and is identified by the Street Gestalt Completion measures and one of the illusions. The bipolarity of the factor indicates that the ability to quickly organize this type of unstructured material into a perceptual whole is related to perceiving a large amount of illusion in the Sanders figures.

Factor C

Tests	Loadings
3. Dotted Outlines	.81
18. Dotted Outlines (time)	.78

Factor C is the only doublet factor obtained in the normal condition. Since both the measures found in this factor represent two methods of scoring the same test, the factor may be considered a specific. Since no other tests in the battery have any significant loading on this factor, it is difficult to determine its meaning.

Factor D

Tests	Loadings
9. Gottschaldt A	.65
12. Shape Constancy	-.64
15. Digits Backward	.52
14. Cancellation of Figures	.45
13. Hidden Pictures	.40
10. Gottschaldt B	.33

This factor is apparently that described as flexibility of closure or as Thurstone also termed it, "freedom from Gestaltbindung." In tests 9, 13 and 10, the subject must suppress one configuration and discover another. In tests 12, 14 and 15 the subject is asked to hold one configuration in mind and work with it against irrelevant or conflicting gestalts. All of these tests require that the subject be relatively flexible in manipulating gestalts or configurations. In Thurstone's study (1944) the Gottschaldt Figures and Shape Constancy were found to

be highly loaded in two factors, one which he described as "the ability to form a perceptual closure against some distractions" (p. 101). The other is the factor referred to in this study as the flexibility of closure or freedom from Gestaltbindung. One might suggest, therefore, that Factor D is the same as Thurstone's perceptual closure factor. That this is not the case is indicated by the presence of the other three tests in this factor, Tests 13, 14 and 15. Hidden Pictures does not appear in Thurstone's perceptual closure factor, but does have the highest loading of all the tests in the flexibility of closure factor. Tests 14 and 15 were not included in Thurstone's battery, but were found by Rimoldi (1948) to identify a factor which he claimed was very similar to Thurstone's flexibility factor. As further evidence in support of the identity of Factor D, it might be mentioned that Thurstone found that Tests 1, 2 and 3 had significant loadings on the closure factor, but none on the flexibility of closure factor. An inspection of the final rotated factor matrix will show that these three tests had negligible loadings on Factor D. Therefore, it can be assumed that this factor represents the ability of flexibility of perceptual closure.

It should be noted that this factor is also bipolar, Shape Constancy having a high negative loading. This was not the case in Thurstone's study. Before offering an explanation for this discrepancy, it might be worthwhile to review briefly the instructions given to the subjects. They were to select the diamond which most nearly resembled the apparent shape of the cardboard. The size of the number given reflects the extent to

which the subject was making a sensory judgment or an object judgment. If he answered "number one," which was the perfect square, he was making a purely object judgment. The number 16 was the diamond which indicated a purely sensory judgment. Because of the educational background and experience of the subjects, plus the fact that many were familiar with the concept of constancy, it seems reasonable to assume that the majority of the subjects were making a sensory judgment. The other tests in this factor demand that the person be object oriented. Therefore, the one test which requires that the person not be object oriented will be negatively related to the others.

Factor E

Tests	Loadings
2. Mutilated Words	.76
17. Mutilated Words (time)	.70
7. Poggendorf Illusion	.67
13. Hidden Pictures	.64
8. Muller-Lyer Illusion	.54
6. Sanders Illusion	.52

The presence of the three illusions in this factor indicates that it corresponds to Thurstone's perceptual illusion factor. That the Mutilated Words test and Hidden Pictures also identify the factor requires some explanation. It would seem that those persons who experience a relatively low amount of illusion perform better both on the Mutilated Words Test and the Hidden Pictures Test. (It must be kept in mind that the illusion tests were scored in such a way that a high score reflected a small amount

of illusion, and that high scores on the other tests reflect better performance). An explanation of this must take into account the fact that the material used in the Mutilated Words test is verbal in nature. Therefore, it would seem that a person who perceives a great deal of illusion in the geometric figures takes a longer period of time before he is able to form closure on incomplete words. Perhaps these subjects are too influenced by the position of the parts making up the letters just as they are too influenced by the position of the lines in the various figures which are illusory. In this case, they would have difficulty in combining the parts into a letter which is part of the word. For example, they may be trying to form a single letter from two adjacent parts, when in reality, one part combines with others to form one letter and the other part combines with still others to form another letter. In other words, those persons who experience a relatively small amount of illusion are not subject to any distortion of the parts making up the letters and therefore, are able to quickly achieve closure to form a letter and then a word. So too, the presence of the Hidden Pictures Test in this factor points to the fact that the ability to find the hidden objects is related to perceiving a small amount of illusion.

Factor F

Tests	Loadings
14. Cancellation of Figures	.49
5. Schroder Stair Figure	.40
17. Mutilated Words (time)	.40
16. Street Gestalt (time)	.32
18. Dotted Outlines (time)	.30
8. Muller-Lyer Illusion	-.30

The loadings of the tests making up this factor are all relatively low. With the exception of the three time measures, the tests appear to be unrelated to each other. It may be that this factor is somehow related to tempo since four of the six tests (14, 16, 17 and 18) identifying it, measure the speed with which the subjects could perform the task within in a given time period. However, if this factor does represent some ability such as the speed of perception, it is difficult to explain the presence of the Schroder Stair Figure and the Muller-Lyer Illusion. Since the loadings of this factor are low, it may be that this is simply a residual factor.

It can be seen that the factor structure obtained in the normal condition is similar but not identical to the structure obtained by Thurstone. However, because the structure is a very close approximation to simple structure and the factors are interpretable, it is psychologically meaningful. Therefore, the structures and the factors obtained in the placebo and four drug conditions will be evaluated and compared in terms of their relationship to the normal condition.

Placebo Condition

Six factors were extracted for the Placebo Condition. Like the normal condition, the structure is quite clear. It is certainly of interest to compare the factorial structure obtained in the Placebo condition with that obtained for the Normal condition. The method of comparison to be employed is to determine the relationship of every factor obtained in the Normal condition to every factor obtained in the Placebo condition. The measure of this relationship is termed the coefficient of congruence or the degree of factorial similarity (Harman, 1960). These measures are not correlation coefficients but have the same range and may be interpreted similarly. The coefficients of congruence between the Placebo and Normal conditions are presented in Table 1 (the letters refer to the factors identified in each condition).

Table 1

Coefficients of Congruence in the Comparison of the Placebo and Normal Conditions

Normal Condition	Placebo Condition A	B	C	D	E	F
A	.04	.01	-.08	.85	.23	.02
B	.60	.13	-.15	-.10	.46	-.13
C	.66	.10	.28	.05	.08	.32
D	.10	.54	-.25	.17	.17	.36
E	-.14	.24	.69	.00	.33	.51
F	.08	.51	.16	.15	.26	.19

The identity of each of the factors obtained in the Placebo condition will now be presented. Reference will be made to congruent factors as indicated in Table 1 in the appropriate places.

Factor A

Tests		Loadings
3.	Dotted Outlines	.83
18.	Dotted Outlines (time)	.67
16.	Street Gestalt (time)	.54
1.	Street Gestalt	.48
6.	Sanders Illusion	-.44

As indicated in Table 1, Factor A is congruent with both Factor B and Factor C of the Normal condition. What existed as a doublet in the Normal condition (the two dotted Outlines measures) is found with three other tests (16, 1 and 6) in the Placebo condition. Reference to the cosine matrix* (Table 22 of the Appendix) indicates that even in the Normal condition, there is a positive relationship between Factor B and Factor C. Therefore, the fact that they should combine into one factor in the Placebo condition is not too surprising.

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* A negative cosine for the reference axes of two hyperplanes shows a positive relationship for the hyperplanes involved, and vice-versa.

Factor B

Tests	Loadings
13. Hidden Pictures	.71
14. Cancellation of Figures	.69
12. Shape Constancy	-.66
2. Mutilated Words	.33

This factor corresponds to the flexibility of closure factor. Tests 13, 14 and 12 are highly loaded in this factor as well as in the flexibility factor of the Normal condition. However, three other tests which appear in this factor in the Normal condition have insignificant loadings in Factor B, accounting for the lower coefficient of congruence. As was apparent in the Normal condition, the factor is bipolar, shape constancy again having a high negative loading. The presence of the Mutilated Words test is difficult to interpret but its loading is quite low and perhaps insignificant. As can be seen in Table 1, Factor B is also somewhat similar to Factor F of the Normal condition. Test 14 is the only test which has sizable loadings in both factors. It will be recalled that the interpretation of Factor F was rather uncertain, and therefore, the relationship between it and this factor is equally uncertain.

Factor C

Tests		Loadings
7.	Poggendorf Illusion	.75
17.	Mutilated Words (time)	.69
6.	Sanders Illusion	.62
2.	Mutilated Words	.54
18.	Dotted Outlines	.39

This factor is closely related to the perceptual illusion factor obtained in the Normal condition, in spite of the fact that the loadings of the Muller-Lyer Illusion and the Hidden Pictures test in this factor are negligible. The two measures of the Mutilated Words test are seen to be highly loaded in the same factor as two of the illusions in both the Normal and Placebo conditions. Therefore, the interpretation of their presence offered earlier seems valid. The presence of the Dotted Outlines (time) test in this factor is somewhat surprising but may be related to its similarity to the Mutilated Words test. Both tests require that the subject integrate unorganized material into a perceptual whole. Again, it seems that those persons who perceive a relatively small amount of illusion have less difficulty in accomplishing this task.

Factor D

Tests		Loadings
11.	Retinal Rivalry Reversals	.77
4.	Necker Cube	.66
5.	Schroder Stair Figure	.60
9.	Gottschaldt A	.33
15.	Digits Backward	.31

Of the factors obtained in the placebo condition, Factor D has the highest degree of relationship with one of the Normal condition factors (coefficient of congruence equals .85). The factor represents the rate of alternations or reversals. This factor differs somewhat from the reversal factor obtained in the Normal condition in that both of the Gottschaldt tests have lower loadings. Gottschaldt A is still present but the saturation of Gottschaldt B is negligible. In the interpretation of the reversal factor in the Normal condition, it was pointed out that the presence of the Gottschaldt tests in the factor could be explained on the basis of what the subject must do in order to find the embedded figures; namely, shift their perspective of the figures. Since only the Gottschaldt A test appears in the reversal factor in the Placebo condition and its loading is rather low, it would seem that this shifting of perspective which occurred in the Normal condition was present in the Placebo condition only to a limited degree. The loading of the Digits Backward Test on this figure is quite low and its relevance is somewhat doubtful.

Factor E

Tests		Loadings
2.	Mutilated Words	.69
17.	Mutilated Words (time)	.67
1.	Street Gestalt	.66
16.	Street Gestalt (time)	.51
9.	Gottschaldt A	.44
10.	Gottschaldt B	.44

This factor is not congruent with any of the factors found in the Normal condition. The highest coefficients are with Factor B and Factor E of the Normal condition. This factor contains both the Mutilated Words tests in common with Factor B of the Normal and both the Street Gestalt tests in common with Factor E of the Normal. Interestingly enough, this factor has a high resemblance to a factor found by Thurstone (1944) but which was not obtained in the Normal condition. It is the factor which Thurstone says "represents the ability to form a perceptual closure against some distractions" (p. 101). All of the tests which identify Factor E in this condition were found by Thurstone to be highly loaded in the factor he described. However, he also found that shape constancy was highly loaded in this factor, while here, it has only a very small saturation in Factor E. If this factor is the perceptual closure factor described by Thurstone, it is not clear why this factor should be recovered in the Placebo condition and not in the Normal condition. It is difficult to understand why a placebo should alter the factorial identity of these tests.

Factor F

Tests		Loadings
2.	Mutilated Words	.56
17.	Mutilated Words (time)	.56
8.	Muller-Lyer Illusion	.57
9.	Gottschaldt A	.42
14.	Cancellation of Figures	.36

The presence of the Mutilated Words test and the Muller-Lyer Illusion accounts for the relationship between this factor and the Illusion factor found in the Normal condition. Since the Mutilated Words tests appear with the illusions in two factors of the Placebo condition, it might be thought that these two factors are related to each other. Reference to the cosine matrix (Table 24) indicates that there is only a very slight negative relationship between them. The interpretation of this factor is quite unclear, primarily because of the presence of the Gottschaldt A test and the Cancellation of Figures in the factor.

The factorial structure obtained when the subjects were under the influence of a placebo, though quite clear, definitely was affected by the introduction of the capsule. The structure is not identical to the structure obtained for the Normal condition, but most of the factors are similar to those extracted in that condition. It seems obvious that subjects operating in a situation in which they know they might have been administered a drug, perform differently than in a situation in which no capsule has been administered.

Each of the factorial structures obtained in the four drug conditions will now be presented. The factors obtained in each of these conditions will be compared to those obtained in the Normal condition. Also, the factorial structures for the two depressants will be compared as well as those for the stimulants. In the following interpretation of the factors, hypotheses are occasionally offered as to the reasons why the com-

position of certain factors has changed. It should be stressed here that these are hypotheses and not necessarily statements of fact.

Atropine Condition

Six factors were extracted; of these, two were bipolar. The structure obtained for this condition is quite dissimilar to those obtained in the Normal and Placebo conditions, both in the composition of the factors and the clarity of the structure. The coefficients of congruence between the factors obtained in the Atropine condition and those obtained in the Normal condition are presented in Table 2.

It can be seen in Table 2 that only four of the factors obtained in the Atropine condition are related to factors obtained in the Normal condition. During the presentation of the individual factors which follows, it might be well to keep in mind that atropine is a cholinergic blocker inhibiting the action of the parasympathetic nervous system.

Factor A

Tests	Loadings
17. Mutilated Words (time)	.84
2. Mutilated Words	.82
10. Gottschaldt B	.63
8. Muller-Lyer Illusion	.58

This factor corresponds to Factor E of the Normal condition in which it was found that the ability to form words from unstructured material is related to the perception of a relatively small amount of

Table 2

Coefficients of Congruence in the Comparison of the Atropine and Normal Conditions

	Atropine Condition					
Normal Condition	A	B	C	D	E	F
A	.15	-.18	.61	.43	.33	-.18
B	-.20	.73	.04	.01	-.23	.11
C	.33	.37	.10	.47	.18	.04
D	.22	.11	.31	.20	.09	.58
E	.62	-.26	.31	.36	-.19	.22
F	.18	.13	.30	.37	-.17	.10

illusion. However, atropine affects the composition of the factor to the extent that the Muller-Lyer test is the only illusion with an appreciable saturation on the factor. As will be seen in the following factors, the Muller-Lyer is the only one of the three illusions which has a significantly high positive loading in any of the factors obtained in the Atropine condition. This means that only in the Muller-Lyer illusion was a low amount of illusion important in identifying the factor. The most obvious interpretation of this finding is that it is somehow related to the fact that Atropine causes dilation of the pupil and inhibition of accomodation which may result in slightly blurred vision. In as much as the Muller-Lyer figures are less complex than the other two illusions, it may be that they are less susceptible to the effects of Atropine than are the other illusions. By the same token, the presence of the Gottschaldt B test on this factor seems to indicate that under Atropine, good performance on this test is related to the pereeption of a low amount of illusion on the Muller-Lyer drawings.

Factor B

Tests		Loadings
16.	Street Gestalt (time)	.85
1.	Street Gestalt	.71
3.	Dotted Outlines	.59
7.	Poggendorf Illusion	-.46
18.	Dotted Outlines (time)	.30
6.	Sanders Illusion	-.28

The highest coefficient of congruence for the Atropine condition is between Factor B and Factor B of the Normal Condition. In this factor there is the relationship between the ability to form both pictures (Tests 1 and 16) and letters or numbers (Tests 3 and 18) out of unstructured material and the perceptual illusions. However, in this factor, it is the perception of a relatively large amount of illusion which is related to the other tests. In the Normal condition this relationship was true only for the Street Gestalt test, but in the Atropine condition, it is also true for the Dotted Outlines test. Perhaps a slight blurring of vision renders these two tests more similar than they actually are, since the blurring would cause the small fragments making up the picture to be perceived, not as sharply defined parts, but as fuzzy dots.

Factor C

Tests	Loadings
5. Schroder Stair Figure	.78
6. Sanders Illusion	-.63
4. Necker Cube	.50
9. Gottschaldt A	.36
10. Gottschaldt B	.35

This factor corresponds to the rate of alternation factor obtained in the Normal condition. Both of the Gottschaldt tests as well as the reversal figures are present in both factors. What is surprising, however,

is the absence of the Retinal Rivalry Reversals, since this test remains intact in the factor in all of the other conditions. The failure of this test to appear in the rate of alternation factor may be due to the inhibition of accomodation caused by the atropine. The Retinal Rivalry Reversals test may have been the only test of those normally identifying this factor in which the accomodation problem was important. For example, the cardboards showing the Necker Cube and the Schroder Stair Figure were placed quite a distance from the subject and therefore, accomodation for near objects was unnecessary. So too, the Gottschaldt tests were administered on paper and the subject was free to place the paper at any distance which was comfortable for him. However, when taking the Retinal Rivalry Test, the subject had to hold the stereoscope directly up to his eyes. He was not free to hold it at a more comfortable distance. Therefore, it seems likely that the inhibition of accomodation caused by the atropine interferred with the Retinal Reversals, thereby altering the factorial identity of the test.

Only in the Atropine condition does the Sanders Illusion appear in the rate of alternation factor. Its bipolarity to the other tests indicates that under Atropine, a relatively large amount of illusion is related to reversal rate.

Factor D

Tests		Loadings
14.	Cancellation of Figures	.61
13.	Hidden Pictures	.59
18.	Dotted Outlines (time)	.54
11.	Retinal Rivalry Reversals	.45
3.	Dotted Outlines	.42
4.	Necker Cube	.37
6.	Sanders Illusion	.33

As indicated in Table 2, this factor is not congruent with any of the factors obtained in the Normal condition. Its interpretation is quite doubtful in as much as the tests identifying the factor seem to reflect various types of ability. It should be pointed out that with the exception of the Hidden Pictures test, all of the tests appearing in this factor also have appreciable loadings in at least one other factor.

Factor E

Tests		Loadings
15.	Digits Backward	.72
4.	Necker Cube	.37
11.	Retinal Rivalry Reversals	.36

This factor is also not congruent with any of the factors obtained in the Normal condition. It is identified primarily by the Digits Backward test with relatively low loadings on two of the reversal tests.

Factor F

Tests	Loadings
12. Shape Constancy	-.54
14. Cancellation of Figures	.37
1. Street Gestalt	.36
9. Gottschaldt A	.36
8. Muller-Lyer Illusion	.35

There is some relationship between this factor and the flexibility of closure factor obtained in the Normal condition. The Shape constancy test again has a high negative loading as observed in both the Normal and Placebo conditions. Present in this factor but not in the Normal or Placebo conditions are the Street Gestalt test and the Muller-Lyer illusion but their loadings are quite low.

From the presentation of the individual factors, it can be seen that atropine had a very obvious effect on the factorial structure. It is not nearly as clear as either the Normal or Placebo structures, ten of the eighteen measures having appreciable loadings on at least two factors. Even though four of the factors show some relationship to factors of the Normal condition, their composition varies considerably.

Dexedrine Condition

Since dexedrine, like atropine, is a stimulant, the factorial structure obtained for that condition will be presented now. While atropine acts as a stimulant by blocking the actions of the parasympathetic nervous system, dexedrine acts as a stimulant by stimulating the activity of the sympathetic nervous system.

Table 3

Coefficients of Congruence in the Comparison of the Dexedrine and Normal Conditions

	Dexedrine Condition					
Normal Condition	A	B	C	D	E	F
A	.25	.14	.14	.43	.73	.36
B	.12	.76	-.14	-.03	-.13	-.04
C	.70	-.16	.19	.09	.12	-.06
D	.30	.30	-.12	.55	-.23	-.18
E	-.16	-.12	.76	-.10	-.02	.24
F	.29	.41	.27	-.03	.17	.30

Table 3 indicates that five of the factors obtained in the Dexedrine condition are congruent with factors of the Normal condition.

Factor A

Tests		Loadings
3.	Dotted Outlines	.88
18.	Dotted Outlines (time)	.78
9.	Gottschaldt A	.40
11.	Retinal Rivalry Reversals	.32
14.	Cancellation of Figures	.32

Both from the composition of the factor and the value of the coefficient of congruence (.70), it is obvious that this factor corresponds to the doublet of the Dotted Outlines measures obtained in the Normal condition. The difference between the two factors is the presence of Tests 9, 11, and 14 in the Dexedrine factor and their loadings are relatively low, particularly in comparison with the other two values.

Factor B

Tests		Loadings
16.	Street Gestalt (time)	.72
13.	Hidden Pictures	.62
1.	Street Gestalt	.61
8.	Muller-Lyer Illusion	-.53
9.	Gottschaldt A	.44
6.	Sanders Illusion	-.42
14.	Cancellation of Figures	.41
7.	Poggendorf Illusion	-.36

This factor corresponds to the factor obtained in both the Normal and Placebo conditions in which good performance on the Street Gestalt test is related to the perception of a relatively large amount of illusion. In the Dexedrine condition all three of the illusions are included in the factor, whereas in the Normal condition only the Sanders Illusion was present. In addition, this relationship of performance and large amount of illusion, holds also for the Hidden Pictures test, and to a lesser extent, the Gottschaldt A and Cancellation of Figures test.

Factor C

Tests		Loadings
2.	Mutilated Words	.86
17.	Mutilated Words (time)	.81
1.	Street Gestalt	-.41
6.	Sanders Illusion	.34
7.	Poggendorf Illusion	.31

The tests identifying this factor are the same ones which have high loadings on Factor E of the Normal condition indicating that dexedrine had little effect on this factor. One rather interesting difference between the Dexedrine and Normal conditions is the consideration of the Hidden Pictures test. Under the Normal conditions, performance on this test is related to the perception of less illusion and so appears in Factor E. However, in the Dexedrine condition, it does not appear in Factor C which corresponds to Factor E. Rather, it has a high loading on Factor B (see above) indicating that Dexedrine affected

performance on this test to the extent that it is related to the perception of a large amount of illusion, rather than a small amount.

Factor D

Tests		Loadings
10.	Gottschaldt B	.64
9.	Gottschaldt A	.53
15.	Digits Backward	.50
7.	Poggendorf Illusion	-.40

This factor shows a rather low relationship to the factor obtained in the Normal condition termed "flexibility of closure." The correspondence of the two factors is due to the presence of Tests 9, 10 and 15 in both factors. However, the presence of the Poggendorf Illusion in this factor, plus the absence of Tests 12, 13 and 14 would seem to indicate that the factor here represents an ability which varies somewhat from that obtained in the Normal condition.

Factor E

Tests		Loadings
4.	Necker Cube	.76
11.	Retinal Rivalry Reversals	.59
5.	Schroder Stair Figure	.58
12.	Shape Constancy	.49

The presence of the three reversal tests indicates that this is the rate of alternation factor. The positive loading of the Shape Constancy test on this factor is quite surprising since it does not appear on the alternation factor in either the Placebo or the Normal condition.

Factor F

Tests		Loadings
14.	Cancellation of Figures	.49
11.	Retinal Rivalry Reversals	.46
6.	Sanders Illusion	.39
7.	Poggendorf Illusion	.38
5.	Schnoder Stair Figure	.34

This factor appears to be a residual factor in as much as the loadings on the five tests are all quite low. Therefore, it will not be interpreted.

The factorial structure obtained for the Dexedrine condition is more similar to the Normal condition than was the structure of the Atropine condition. However, even between the Dexedrine and Normal conditions, there were considerable variations in the composition of the factors.

Since both atropine and dexedrine are stimulants, it is of interest to determine the degree of relationship between the factors obtained in each of these conditions. This data is presented in Table 4.

As can be seen in Table 4, in the comparison of the Atropine and Dexedrine conditions, four congruent factors are obtained, although for only one factor is the degree of relationship high. The most related factors are those in which the Mutilated Words measures and the illusions have high loadings. There is also some relationship between the factors which have the Street Gestalt measures and the illusions in common. Factor D of the Atropine condition has some congruence with two of the factors found in the Dexedrine condition, the Dotted Outlines factor and

Table 4

Coefficients of Congruence in the Comparison of the Atropine and Dexedrine Conditions

	Atropine Condition					
Dexedrine Condition	A	B	C	D	E	F
A	-.01	.45	.35	.55	.18	-.02
B	-.09	.61	.33	.20	-.25	.30
C	.75	-.26	-.07	.20	-.08	-.14
D	.36	.17	.29	-.12	.27	.14
E	-.05	-.28	.46	.49	.41	-.41
F	.00	-.02	.02	.61	.28	.35

the factor thought to be a residual. It is interesting that this is the only comparison in which there was no congruence between the rate of alternations factor. This is due to the lack of the Retinal Rivalry Reversals tests on the factor in the Atropine condition.

Physostigmine Condition

Physostigmine is a cholinergic stimulant, enhancing the action of the parasympathetic nervous system. Six factors were extracted in this condition, three of them bipolar. The factors obtained in this condition will be compared with those obtained in the Normal condition (Table 5) and each of them interpreted.

It can be seen in Table 5 that only three factors obtained in the Physostigmine condition are related to factors obtained in the Normal condition, Factors A, C, and D.

Factor A

Tests		Loadings
11.	Retinal Rivalry Reversals	.70
5.	Schroder Stair Figure	.66
13.	Hidden Pictures	.63
14.	Cancellation of Figures	.59
4.	Necker Cube	.57
9.	Gottschaldt A	.52
10.	Gottschaldt B	-.51

This factor is related to Factor A of the Normal condition and therefore, corresponds to the rate of alternation factor. The five tests which identify this factor in the Normal condition also have high

Table 5

Coefficients of Congruence in the Comparison of the Physostigmine and Normal Conditions

Normal Condition	Physostigmine Condition A	B	C	D	E	F
A	.56	-.10	.09	.17	.09	.39
B	.09	-.13	.04	.79	.09	.14
C	.04	.28	.68	.03	.43	-.04
D	.32	-.23	.27	-.05	.29	-.13
E	.14	.44	.12	-.13	.12	.40
F	.51	-.03	.26	.03	-.30	-.01

loadings in Factor A of the Physostigmine condition. However, the Gottschaldt B test has a high negative loading in the Physostigmine condition while in the Normal condition it has a high positive loading. The fact that the loadings of these two tests are reversed in sign lowers the value of the coefficient of congruence. If the two tests had the same sign, the value would be considerably higher. One possible interpretation of this difference in sign is that it may be due to the most characteristic effects of Physostigmine; namely, constriction of the pupil and spasm of accomodation. These may result in a narrowed perceptual field at any given instant. As mentioned previously, the Gottschaldt B test is similar to the A test except that it is more difficult. Its increased difficulty stems from the fact that the figures in which the simple figures are embedded are quite complex, being composed of many irrelevant elements, actually designed to hide the figure. The Gottschaldt A test is a much simpler design, the embedded figures being quite obvious (see Figure 1 for a comparison of the two tests). When a person's perceptual field is restricted, as may occur under the influence of physostigmine, the Gottschaldt A test would be little affected and its factorial identity would remain unchanged. However, it is possible that under the same conditions, a person would experience real difficulty in finding the embedded figures in the myriad of conflicting and confusing lines, and so takes a longer period of time and/or makes many mistakes on the Gottschaldt B test. It might be pointed out that only in the Physostigmine condition does this test have

such a high negative loading.

The narrowing of the perceptual field due to constriction of the pupil and spasm of accomodation, while it hinders performance on the Gottschaldt B test, probably accounts for the presence of the Hidden Pictures test and Cancellation of Figures test in this factor. The restricted visual field, in combination with the rapid shifting of perspective, would make it possible for subjects to quickly find the hidden objects and also to select the figures that are identical to the sample ones. As far as these two tests are concerned, the shifting of perspective assumes importance only in a situation in which there is spasm of accomodation and the pupils are constricted, since neither of the tests have appreciable loadings in the alternation factor obtained in the other conditions.

Factor B

Tests	Loadings
2. Mutilated Words	.70
17. Mutilated Words (time)	.64
7. Poggendorf Illusion	.47
9. Gottschaldt A	-.46
8. Muller-Lyer Illusion	.36

This factor is not congruent with any of the factors obtained in the Normal condition. The presence of the two Mutilated Words measures and two of the illusions make it most similar to Factor E but the value of the coefficient is quite low. Nevertheless, physostigmine does not seem to affect performance in the Mutilated Words test since the ability to form rapid closure on this type of material is still related to the

perception of a relatively small amount of illusion. Why physostigmine should affect performance on the Gottschaldt A test in such a way that it appears in this factor is unclear.

Factor C

Tests		Loadings
18.	Dotted Outlines	.65
3.	Dotted Outlines (time)	.63
9.	Gottschaldt A	.47
14.	Cancellation of Figures	.38

Factor C in congruent with the factor found in the Normal condition to be identified by the two measures of the Dotted Outlines test. In the Normal condition, this factor is a doublet, but in the Physostigmine condition, the Gottschaldt A test and the Cancellation of Figures test also appear in this factor. The appearance of these tests make this factor very similar to Factor A obtained in the Dexedrine condition.

Factor D

Tests		Loadings
1.	Street Gestalt	.77
16.	Street Gestalt (time)	.71
7.	Poggendorf Illusion	-.44
4.	Necker Cube	.40
8.	Muller-Lyer Illusion	-.39
6.	Sanders Illusion	-.33

This factor is obviously bipolar and closely related to Factor B of the Normal condition, also bipolar. This is the factor which indicates that good performance on the Street Gestalt test is related to the experience of a relatively large amount of illusion on the geometrical drawings. In

the Normal condition, only the Sanders Illusion had a sizable saturation on this factor while in the Physostigmine condition, all three of the illusions are included. It is difficult to explain the presence of the Necker Cube test in this factor, especially since the Schroder Stair Figure with which it is closely related, has a negligible saturation.

Factor E

Tests	Loadings
15. Digits Backward	.51
1. Street Gestalt	.44
3. Dotted Outlines	.35

Factor E is not congruent with any of the factors obtained in the Normal condition, and its interpretation is quite doubtful. Tests 1 and 3 are similar but seem to have little in common with Test 15.

Factor F

Tests	Loadings
6. Sanders Illusion	.56
7. Poggendorf Illusion	.49
11. Retinal Rivalry Reversals	.37

Although two of the illusions are present in this factor, it is not congruent with any of the factors obtained in the Normal conditions.

Chlorpromazine Condition

Chlorpromazine, an adrenergic blocker, is a depressant of the sympathetic nervous system. For the Chlorpromazine condition, six factors were extracted, and of these, two were bipolar. Unlike the Physostigmine

condition, the structure obtained in this condition is quite clear. As in the other conditions, each factor obtained in the Chlorpromazine condition was compared with the factors obtained in the Normal condition to determine their relationship. These data are presented in Table 6.

Table 6 indicates that every factor obtained in the Chlorpromazine condition is congruent with a factor obtained in the Normal condition. This is quite different from the structure obtained for the Physostigmine condition in which only three factors were congruent. A description of each of the factors obtained in the Chlorpromazine condition follows.

Factor A

Tests		Loadings
2.	Mutilated Words	.78
13.	Hidden Pictures	.69
17.	Mutilated Words (time)	.62

This factor corresponds to Factor E of the Normal condition. Chlorpromazine seems to have had little effect on this factor since these three tests are also present in the factor in the Normal condition. More will be said about the relation of this factor to Factor E of the Normal condition when Factor C is described.

Factor B

Tests		Loadings
5.	Schroder Stair Figure	.82
11.	Retinal Rivalry Reversals	.71
4.	Necker Cube	.69
12.	Shape Constancy	.44
9.	Gottschaldt A	.39
16.	Street Gestalt (time)	.34

Table 6

Coefficients of Congruence in the Comparison of the Chlorpromazine and Normal Conditions

	Chlorpromazine Condition					
Normal Condition	A	B	C	D	E	F
A	.21	.79	-.08	.44	.11	.03
B	.15	.07	-.29	.10	.62	.04
C	.30	.01	-.03	.20	.17	.60
D	.18	.02	.05	.54	.06	.06
E	.72	-.02	.57	-.21	.00	.13
F	.28	.39	-,10	-.16	-.02	.34

The rate of alternation factor in the Chlorpromazine condition is very similar to that obtained in the Normal condition (coefficient = .79). As also occurred in the Placebo condition, the Gottschaldt B test has only a very small saturation on this factor. It may be that on the more difficult test, the subjects tended to shift perspective in attempting to find the embedded figure, only when they were in a completely capsule-free situation. They might have had difficulty in finding the embedded figure in all conditions, but only in the Normal situation did they actively shift perspective. The loading of the Street Gestalt (time) test is quite low and its presence is rather unclear in terms of the interpretation of the factor. The high positive loading of the Shape Constancy test in this factor also occurred in the Dexedrine condition.

Factor C

Tests	Loadings
6. Sanders Illusion	.82
8. Muller-Lyer Illusion	.75
7. Poggendorf Illusion	.27

This factor has some relationship to Factor E of the Normal condition. Factor A (tests 2, 13 and 17) was also congruent to Factor E. These two factors (A and C) of the Chlorpromazine condition are identified by the same tests which have loadings in Factor E of the Normal condition. The cosine matrix of the Chlorpromazine condition (Table 30 of the Appendix) indicates that there is a positive relationship between these two factors which is not unexpected.

Factor D

Tests	Loadings
15. Digits Backward	.69
10. Gottschaldt B	.49
7. Poggendorf Illusion	-.45
9. Gottschaldt A	.36
1. Street Gestalt	.33

The presence of the Gottschaldt Tests and the Digits Backward test are responsible for this factor's relationship to the flexibility of closure factor (D) found in the Normal condition. Interestingly enough, these same tests identify one of the factors found in the Dexedrine condition. Also interesting is the fact that only in the Chlorpromazine and the Physostigmine conditions do the Digits Backward test and the Street Gestalt test appear in the same factor.

Factor E

Tests	Loadings
16. Street Gestalt (time)	.58
1. Street Gestalt	.57
12. Shape Constancy	.37
13. Hidden Pictures	.37

This factor is most closely related to Factor B of the Normal condition due to the high saturation of the two measures of the Street Gestalt test on both factors. Hidden Pictures has a significant loading on this factor but on the same factor in the Normal condition is only .27. Shape constancy also appears in this factor with a positive loading, indicating that the making of a sensory judgment is related to the ability of forming an object out of

disorganized material and of finding objects hidden in a picture.

Factor F

Tests		Loadings
18.	Dotted Outlines	.73
3.	Dotted Outlines (time)	.57
14.	Cancellation of Figures	.42
11.	Retinal Rivalry Reversals	.41
10.	Gottschaldt B	-.37

Again, it is the presence of two measures (18 and 3) which primarily accounts for this factor's congruence to one of the factors obtained in the Normal condition. The factor in the Normal condition is a doublet but here, three other tests also have loadings in the factor.

Reference to Table 6 shows that, in general, Chlorpromazine had a comparatively small effect on the factorial structure of the perceptual battery in terms of its similarity to the Normal structure. This is even more apparent when one examines Table 5 and determines the extent to which Physostigmine altered the structure. Since Chlorpromazine and physostigmine both tend to act as depressants, one blocking the sympathetic nervous system and one stimulating the parasympathetic nervous system, it is of interest to determine the similarity of their factorial structure. Table 7 presents the coefficients of congruence for these two conditions.

An examination of Table 7 reveals that four factors obtained in the Physostigmine condition are congruent with factors obtained in the Chlorpromazine condition, although one of the coefficients is rather low. The three factors showing the highest relationship are the rate of alternation

Table 7

Coefficients of Congruence in the Comparison of the Physostigmine and Chlorpromazine Conditions

Chlorpromazine Condition	Physostigmine Condition A	B	C	D	E	F
A	.35	.26	.25	.08	.23	.09
B	.67	.06	.04	.32	-.10	.36
C	.01	.24	-. 18	-.41	.17	.42
D	-.02	.11	-.02	.36	.50	-.29
E	.14	-.10	.21	.71	.43	.09
F	.40	.05	.70	-.11	.11	.28

factor, the factor identified by the Street Gestalt measures, and the factor identified by the Dotted Outlines measures. The fourth factor which shows some degree of relationship is the factor in which the Digits Backward test and the Street Gestalt test appear.

The data point to the fact that the factorial structure obtained when the subjects were under the influence of physostigmine is more similar to the Chlorpromazine structure than to the structure obtained in the Normal condition. The Chlorpromazine structure, however, is quite similar to the Normal condition. Therefore, it would appear that the introduction of physostigmine disturbs the factorial identity of the various perceptual tests to a much larger degree than does the introduction of chlorpromazine. Too, the effects of physostigmine and chlorpromazine on the factorial structures are somewhat similar.

Discussion

Much of the material which would ordinarily be included in the Discussion has already been presented in the Results section. The most adequate method of handling the data was to interpret the factors immediately after their presentation.

Initially, it would be well to discuss some of the problems which naturally arise in an investigation of the type described in this report. For example, it might be objected that the differences obtained in the various structures which were ascribed as being due to the effects of the drugs may simply have been artifacts resulting from the design of the study.

The first question raised might refer to the number of subjects employed. However, it would appear that the rather small sample size did not have any serious effects on the results. This contention is supported by two findings of the study. The first is that the factorial structure obtained in the Normal condition is similar to that obtained by Thurstone in his study of perceptual behavior (1944). What differences do occur, seem reasonable, particularly in terms of the educational level and background of the subjects. Too, there is only slight variation in the composition of the factors obtained in the Placebo and Normal conditions. The high degree of similarity between the three factorial structures, Thurstone's, the Normal, and the Placebo, would not have been obtained if the size of the sample were too small for valid and meaningful results.

Another point to be considered in this connection is concerned with the control of two important variables, the effect of learning and practice, and the equality of the six forms of the various tests. The experimental design of the study was such that the effects of these variables would not influence the effects of the various drugs. The nature of the investigation made it impossible to eliminate practice and learning, and also demanded the use of six forms of some tests. Since the effects of these conditions were impossible to eliminate, the only alternative was to attempt to distribute them equally through all the conditions. Even assuming that one form of a particular test was more difficult than the other five, the fact is that this test appeared equally often in each of the six conditions. The same is true for the effect of practice and learning; each stage of practice and learning occurred equally often in each of the six conditions. Of course, the possibility does exist that one of the drugs may have had a greater effect on these variables than the others. Admittedly, the design of the present experiment does not account for this possibility. However, assuming that this is not the case, the attempt to control the effects of learning and practice as well as the equality of the tests seems to have been successful as indicated by the similarity of the Normal and Placebo structures.

One other consideration should be mentioned. As was indicated in the Method section, some of the tests included in the battery were shorter

in length than those used by Thurstone. Actually, only five of the tests were adapted in such a way that there were fewer items per test than in the Thurstone battery. Of these, only Tests 1, 2 and 3 (Street Gestalt, Mutilated Words, and Dotted Outlines) seem to have been affected. Thurstone found that they appeared in a single factor which he termed "Speed of Perceptual Closure." In the present study, in both the Normal and Placebo conditions (as well as some of the drug conditions), these tests appear in three different factors: Street Gestalt with a high amount of illusion, Mutilated Words with a low amount of illusion, and the Dotted Outlines as a specific. Apparently, when these tests contain fewer items, their factorial identity is altered. Nevertheless, it must be stressed that it was not the intention of this investigation to merely replicate Thurstone's study. The purpose of the study was to investigate what changes, if any, would occur in the factorial structure when the subjects were under the influence of certain pharmacological agents. The Thurstone battery was used simply as the means by which this aim could be accomplished. Once it was established that there was a clear and meaningful structure obtained in the Normal and Placebo conditions, even though it varied somewhat from Thurstone's, it could then be assumed that any changes which occurred in the drug structures were due to the actions of the drugs and not to the fact that a few of the tests were shortened.

In light of the above discussion, it seems reasonable to assume that the results obtained are valid and the changes which did occur are not merely artifacts, but are due to the actions of the various pharmacological

agents employed.

In the Introduction it was hypothesized that the factorial structures obtained when the subjects were under the influence of the stimulants (atropine and dexedrine) would be similar to each other; so too, the structures obtained for the depressant conditions (physostigmine and chlorpromazine) were hypothesized to be similar. A study of the results indicates that neither of these hypotheses were verified. A comparison of the Atropine and Dexedrine structures shows that each structure was more similar to the structure obtained in the Normal condition than to each other. The same is true also for the Physostigmine and Chlorpromazine structures.

What is surprising is the high degree of similarity between the factors obtained in the Dexedrine and Chlorpromazine conditions, both of which show the greatest similarity to the Normal condition. There must be some explanation why these two drugs, one which stimulates the sympathetic nervous system and one which blocks it, should bear the closest relationship to the Normal condition. The most obvious interpretation of this finding is that the dosage level employed was not sufficiently high to affect perceptual behavior to any great extent. It is obvious that if the dose had little effect on performance, then behavior exhibited under each of the conditions would be very similar to that exhibited when no drug had been administered. Also, the behavior would be little changed from one drug condition to the other. While it would seem that the dose employed had little effect on perceptual behavior, it is considered to be the usual therapeutic dose. Furthermore, it has been found that this dose

of dexedrine is sufficient to cause rather drastic changes in measures of personal tempo (Erdmann, 1966).

Also noteworthy is the fact that two factors were obtained in both the Dexedrine and Chlorpromazine conditions which were identical to each other and did not occur in any of the other conditions. One factor contained the three reversal tests and the Shape Constancy test. Not only was this the only factor in which these tests appeared together but it represents the only instance in which Shape Constancy had a high positive loading. The other factor contained the two Gottschaldt tests, the Digits Backward test, and the Poggendorf Illusion with a high negative loading. The relationship between the tests identifying these factors in unknown and the meaning of the factors is quite unclear. What is interesting is that they occur only under drugs which have antagonistic actions. However, it may be that the actions of Dexedrine and Chlorpromazine are not completely opposite to each other in the nervous system. For example, while it is known that dexedrine stimulates the brain stem reticular formation and chlorpromazine suppresses it, the former is due to the direct action of the drug and the letter to indirect action (Bradley, 1962). Therefore, it does not seem too unreasonable to hypothesize that even though these two drugs have antagonistic actions on the sympathetic nervous system, they may have some similar activity in the central nervous system which could account for the similarity in behavior observed in this study.

The two drugs which had the greatest effect on perceptual behavior

were atropine and physostigmine. It would seem that the effect that both of these drugs have on vision is responsible for the behavioral changes observed. As was mentioned in the Results, one of the most consistently observed factors was the one concerned with the rate of alternation. This factor was greatly affected by both atropine and physostigmine although each had a different effect. Atropine altered performance of the Retinal Rivalry test such that it no longer appeared in the factor; physostigmine altered performance on the Gottschaldt B test in such a way that it appeared with a high negative loading. It is believed that these changes can be explained only on the basis of the drugs utilized.

In conclusion, it can be said that perceptual behavior, as exemplified by the tests used in the present battery, was definitely affected by the pharmacological agents employed. Even in the cases of dexedrine and chlorpromazine, whose factorial structures demonstrated the least amount of change from the normal, differences did occur. In all of the drug conditions, the differences which are observed usually take the form of an alternation in the composition of the factors. Tests not present in a factor in the Normal condition have appreciable saturation in the factor in the drug conditions, and conversely, tests which are in the factor in the Normal condition are not present in the drug conditions. The importance and relevance of the changing factorial identity of the various tests under the different drug conditions must be investigated further. In some cases, hypotheses have been offered to explain these changes. In other cases,

meaningful hypotheses were not possible. It remains for additional research to offer verification or rejection of these hypotheses as well as furnish new ones. It almost seems as though this investigation raised more questions than it answered. However, in as much as it was essentially an exploratory study into an area not previously explored in such depth, this was not unexpected.

In regard to the methodological approach employed in this study, one additional and relevant point must be mentioned. It was claimed in the Introduction that the factor analytic approach was not only particularly suited to drug research, but also was perhaps the most adequate method to determine the effects of drugs on behavior. It is believed that the present study verified this contention. An analysis of the various structures did indicate when and where a particular drug affected behavior. The typical method of studying drug effects is to simply determine if two scores are significantly different. This method was also employed in the present study, t tests being computed between the scores obtained in the normal condition and the five other conditions. Only six values were found to be significant at the .05 level. If just this information had been used for analysis, it would have been concluded that the drugs had no effect. However, in the use of factor analysis, changes in behavior were observed which would not have been observed had other methods of analysis been employed.

SUMMARY

Twenty subjects were studied in order to determine the effects of four pharmacological agents on perceptual behavior. All subjects were administered a battery of fifteen tests of perception based on tests used by Thurstone. Each battery was administered under six conditions: no-capsule administered or Normal, Placebo, .5 mg of Atropine, 2 mg of Physostigmine, 50 mg of Chlorpromazine, and 5 mg of Dexedrine. Both the order of the drugs and the six forms of the tests were presented in a systematic randomized manner so that the effects of learning and practice would not obscure the effects of the drugs.

Intercorrelations between variables for each of the six conditions were computed. Six factor analyses were obtained using the principal axes method and each structure was rotated to the closest possible approximation to simple structure. Coefficients of congruence were computed in order to be able to compare the factors obtained in the various conditions.

It was found that the factorial structure of the Normal condition was quite similar to that obtained by Thurstone and the differences which were present were reasonable and meaningful; they were thought to be due to the differences between the two samples. There were no striking differences between the structures obtained in the Normal and Placebo conditions. Of

the four drug conditions, chlorpromazine and physostigmine bore the closest resemblance to the Normal condition. This was explained as being due to the dosage level employed. While the dose was sufficiently high to cause changes in behavior in other areas (personal tempo), perception was little affected. Certain similarities were pointed out. The structures obtained in both the Physostigmine and Atropine conditions differed quite extensively from the structure of the Normal condition, although they bore little resemblance to each other. These differences were accounted for as being primarily due to the effects of both drugs on vision.

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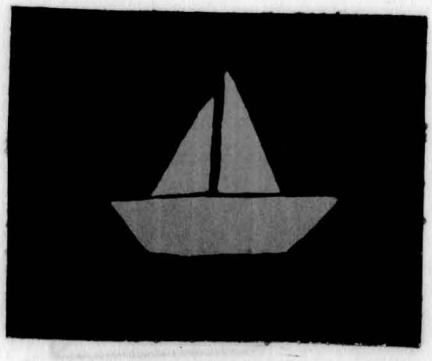
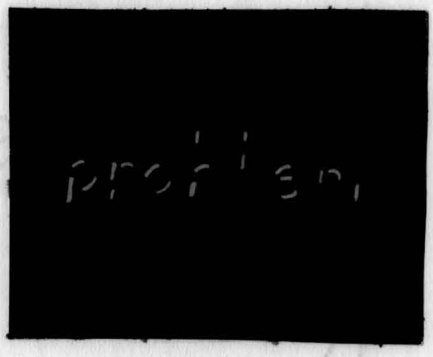
APPENDIX



Sample Item Test Item

Tests 1, 16. Street Gestalt Completion Test



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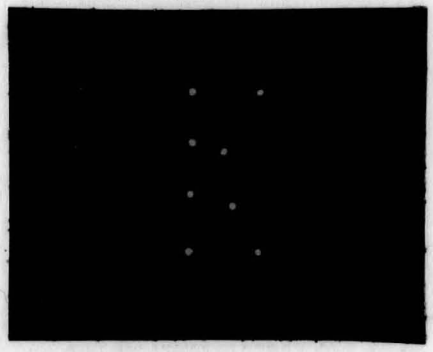
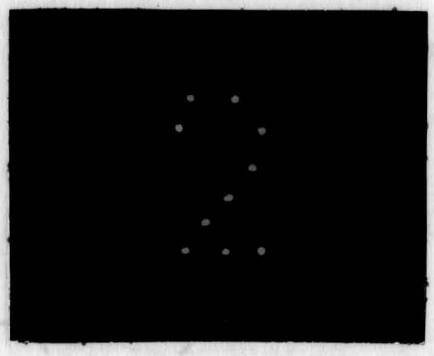
Tests 2, 17. Mutilated Words Test

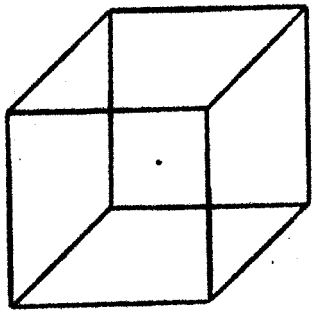




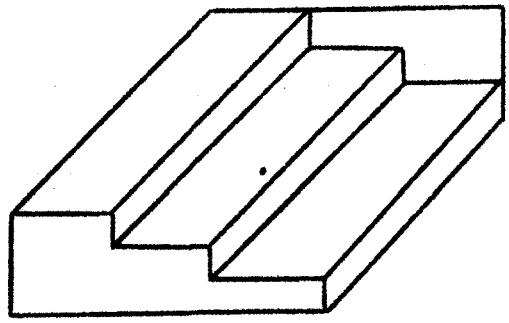
Sample Item Test Item

Tests 3, 18. Dotted Outlines Test

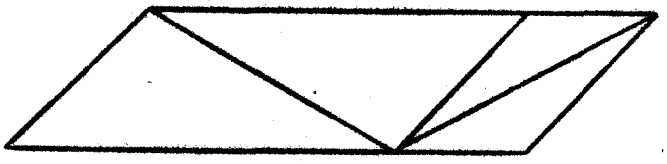
Fig. 1. Examples of items of tests used in perceptual battery.



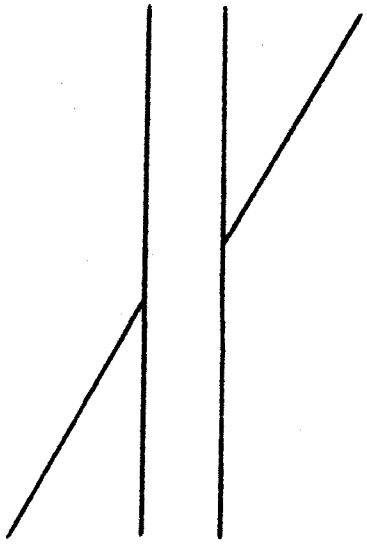
Test 4. Necker Cube



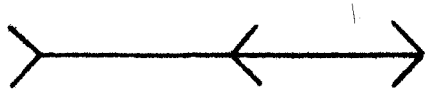
Test 5. Schroder Stair Figure



Test 6. Sanders Illusion

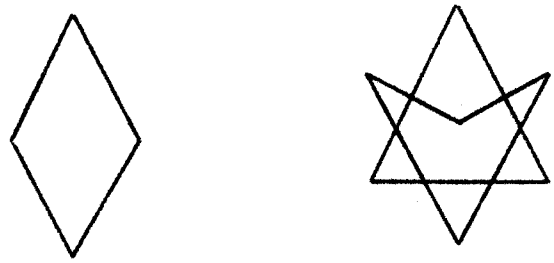


Test 7. Poggendorf Illusion

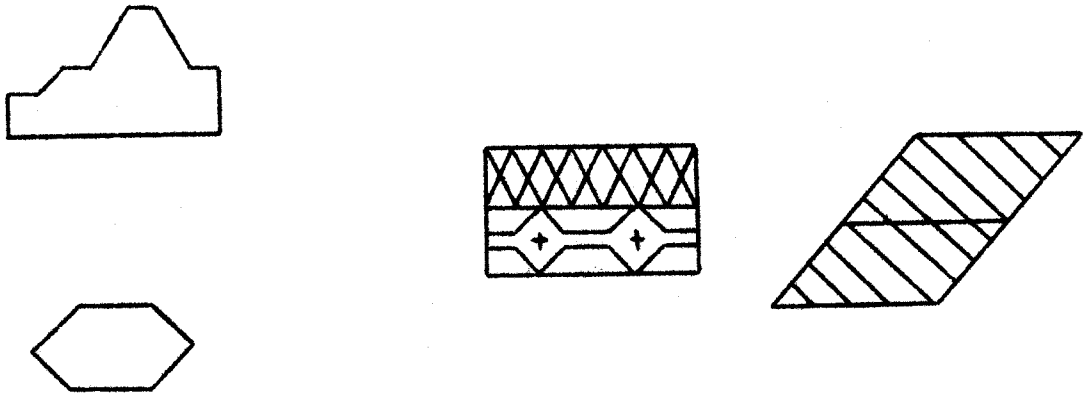


Test 8. Muller-Lyer Illusion

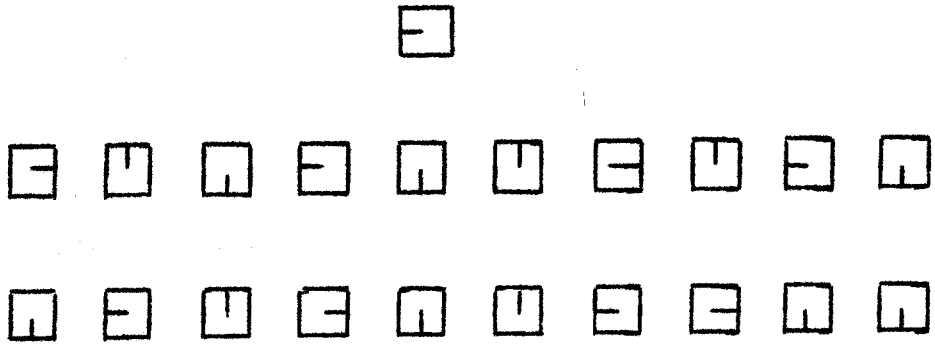
Fig. 1 (con't). Examples of items used in perceptual battery.



Test 9. Gottschaldt A



Test 10. Gottschaldt B



Test 14. Cancellation of Figures

Fig. 1 (con't). Examples of items in tests used in perceptual battery.

Table 8

Communality Values for all Tests in all Conditions

Variable	Normal	Placebo	Atropine	Dexedrine	Physos-tigmine	Chlorpro-mazine
1	397	824	879	526	735	507
2	792	818	924	879	725	870
3	843	812	830	859	758	622
4	783	836	764	685	727	662
5	769	794	852	614	728	739
6	543	608	536	552	792	840
7	512	708	416	563	678	521
8	639	720	559	583	637	736
9	717	585	342	631	645	339
10	458	442	704	556	483	544
11	554	717	537	731	666	713
12	491	537	494	276	128	407
13	733	666	622	528	694	775
14	466	672	802	574	656	488
15	532	188	558	397	520	495
16	552	756	800	540	741	593
17	877	830	901	888	865	923
18	809	852	704	857	898	707

Note.-Decimal places have been omitted.

Table 9

Intercorrelations Between All Variables for the Normal Condition

Variable	Variable																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1																		
2	10																	
3	30	36																
4	-15	13	36															
5	-28	02	-12	60														
6	-21	25	-18	05	16													
7	-06	50	01	01	-06	50												
8	00	31	14	-33	-57	34	29											
9	-16	-04	-20	28	44	04	-11	00										
10	-03	05	11	41	44	-12	-14	-17	37									
11	06	03	-02	64	52	12	03	-06	43	21								
12	07	00	00	36	16	19	-03	-25	-35	-08	15							
13	16	56	10	21	19	19	35	14	56	23	18	-13						
14	-28	-14	00	03	06	-11	-20	01	41	02	-20	-23	17					
15	-04	-22	18	24	-08	-28	-32	04	20	32	-01	-42	-08	29				
16	30	02	07	11	24	-24	-13	-38	25	-18	26	-22	33	19	-05			
17	-07	81	08	23	28	48	42	11	11	-09	17	14	63	02	-38	20		
18	08	35	76	41	26	02	-13	10	04	01	14	02	22	19	16	26	30	

Note.-Decimal places have been omitted.

Table 10

Intercorrelations Between All Variables for the Placebo Condition

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1																		
2	46																	
3	38	-08																
4	45	11	42															
5	36	23	16	79														
6	-05	16	-18	11	26													
7	19	32	07	18	25	57												
8	-48	-15	-15	-31	-49	02	-17											
9	01	34	-27	09	17	-19	-45	04										
10	44	10	-07	22	14	24	-12	-36	25									
11	04	-04	12	67	58	24	24	-19	07	19								
12	-01	-34	13	22	08	-02	-04	21	-01	03	20							
13	-16	08	01	-22	13	-22	-36	-35	10	-17	-20	-51						
14	-17	28	-19	-20	-06	-13	-26	05	30	-38	-18	-54	56					
15	-05	10	-04	08	-06	-04	-18	10	25	09	23	-18	08	23				
16	77	29	34	53	54	-16	08	-52	07	25	11	06	-03	01	-11			
17	40	77	-10	11	16	38	38	10	16	23	-16	-05	-22	08	-09	24		
18	47	06	80	33	25	17	48	-17	-43	-02	08	11	-13	-22	-19	48	21	

Note.-Decimal places have been omitted.

Table 11

Intercorrelations Between all Variables
for the Atropine Condition

Variable	Variable																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1																		
2	-19																	
3	43	36																
4	-17	26	34															
5	-31	20	20	78														
6	-01	14	-03	-22	-47													
7	-16	05	-37	-19	-20	44												
8	-02	43	-24	-08	-29	26	11											
9	-16	32	05	20	30	-12	-02	12										
10	-50	62	11	31	46	01	-04	23	19									
11	-20	08	34	48	36	04	-01	-42	10	-03								
12	-42	27	04	32	14	12	-09	-10	-08	14	32							
13	-04	39	38	20	17	26	01	00	37	08	22	31						
14	22	64	66	37	28	11	03	20	48	22	23	06	54					
15	03	01	19	26	07	00	-30	02	06	-07	28	20	-40	10				
16	81	03	38	-23	-17	-14	-26	-15	-13	-21	-23	-35	-21	15	03			
17	-33	89	12	22	21	21	13	45	23	66	14	41	31	43	03	-09		
18	19	38	72	43	37	14	-04	-22	05	33	27	09	48	58	-08	13	29	

Note.-Decimal places have been omitted.

Table 12

Intercorrelations Between All Variables for the Physostigmine Condition

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1																		
2	16																	
3	08	16																
4	37	45	05															
5	00	25	-25	56														
6	05	-18	-39	-22	-17													
7	-10	40	-24	01	14	60												
8	-23	37	30	-03	-07	17	29											
9	-13	-14	37	13	16	-45	-27	-09										
10	20	20	-21	-19	-32	34	29	-14	-45									
11	17	04	-18	64	63	14	20	08	05	-30								
12	06	11	-12	22	-06	18	00	-16	00	20	03							
13	-21	-35	12	14	35	-28	-28	-27	67	-44	16	-02						
14	02	29	33	47	39	-35	13	24	44	-43	37	04	25					
15	14	32	09	33	08	16	11	39	07	01	-04	00	04	28				
16	68	27	00	48	34	-27	-11	-28	-07	04	27	08	-14	10	-14			
17	13	73	31	37	18	00	50	59	-06	01	08	-06	-37	54	45	21		
18	-37	09	76	-12	-20	-54	-18	15	43	-24	-32	-01	19	42	-18	-20	20	

Note.-Decimal places have been omitted.

Table 13

Intercorrelations Between all Variables for the Chlorpromazine Condition

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1																		
2	-02																	
3	22	22																
4	09	26	04															
5	-08	09	-13	61														
6	-04	32	-29	-04	-09													
7	-25	33	10	-14	-09	43												
8	-02	23	-28	-01	-08	71	17											
9	15	21	-13	36	38	12	-16	-08										
10	41	-19	-09	21	34	-25	-50	01	03									
11	03	15	18	46	63	25	25	01	13	00								
12	18	-10	-19	36	23	02	00	-12	23	00	28							
13	16	70	26	27	-11	22	27	37	12	-21	-01	01						
14	11	21	35	12	02	-17	28	-19	11	-39	34	12	45					
15	38	-19	00	21	11	-24	-28	13	37	31	-21	-24	12	-02				
16	44	-23	-03	38	26	19	-20	15	-02	30	32	33	-02	13	09			
17	-04	88	20	35	13	42	46	27	27	-34	23	-12	70	24	-06	18		
18	00	23	64	35	-04	10	16	-08	29	-38	34	-09	28	47	07	08	43	

Note.-Decimal places have been omitted.

Table 14

Intercorrelations Between all Variables for the Dexedrine Condition

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1																		
2	-22																	
3	-05	31																
4	-12	12	10															
5	09	38	18	61														
6	-34	16	-17	-06	-06													
7	-25	12	-24	-13	-09	46												
8	-07	-18	-33	-18	-34	43	21											
9	28	20	45	25	33	03	-31	-31										
10	-18	05	-16	-04	05	12	-25	11	31									
11	-05	32	44	54	62	17	14	-28	36	-03								
12	09	01	-21	31	15	16	04	-06	07	07	31							
13	46	28	06	31	16	-36	-12	-42	25	-30	-03	-01						
14	44	21	34	-04	26	-13	04	-47	35	-36	31	-16	32					
15	-08	-26	10	19	-10	24	-19	37	14	32	02	-17	-15	-12				
16	32	14	13	-04	17	-16	-22	-59	38	-01	-09	-05	46	26	-24			
17	-33	80	18	18	22	33	05	09	34	46	27	11	02	-05	09	00		
18	-21	17	79	34	35	-09	-21	-32	32	-14	52	13	-12	23	10	-09	09	

Note.-Decimal places have been omitted.

Table 15

Unrotated Principal Axes Factor Solution
For the Normal Condition

	Factor					
Variable	I	II	III	IV	V	VI
1	-02	-10	-31	-20	-34	37
2	65	-56	-21	01	00	12
3	31	-02	-78	-35	14	06
4	62	45	04	-33	27	08
5	56	49	39	-12	00	-22
6	32	-44	37	05	28	-18
7	30	-58	19	08	11	16
8	-02	-54	-26	34	37	17
9	42	43	13	57	00	11
10	26	43	02	08	32	31
11	52	33	26	-15	05	29
12	09	-08	29	-61	05	-12
13	69	-13	-06	39	-19	21
14	06	27	-18	45	-02	-39
15	-10	45	-38	25	30	14
16	28	25	-13	06	-62	05
17	76	-45	13	04	-17	-21
18	53	10	-60	-21	05	-33

Note.-Decimal places have been omitted.

Table 16

Unrotated Principal Axes Factor Solution
for the Placebo Condition

	Factor					
Variable	I	II	III	IV	V	VI
1	76	-23	-03	-21	37	-11
2	36	-68	43	-07	03	19
3	48	31	-36	-48	-01	35
4	76	06	-27	34	-10	22
5	71	-18	-22	32	-32	-05
6	25	09	57	23	-36	-18
7	46	20	54	-11	-38	-09
8	-48	26	32	06	13	55
9	-08	-50	-13	40	28	26
10	34	-12	02	32	35	-30
11	43	17	-19	57	-33	17
12	14	56	-02	26	34	14
13	-23	-50	-40	-25	-34	-15
14	-30	-63	-11	-17	-27	27
15	-10	-21	-12	23	-05	25
16	73	-24	-27	-18	24	-06
17	39	-38	68	-05	19	18
18	65	31	04	-54	-12	15

Note.-Decimal places have been omitted.

Table 17

Unrotated Principal Axes Factor Solution
for the Atropine Condition

	Factor					
Variable	I	II	III	IV	V	VI
1	-26	-81	-36	03	02	15
2	79	14	-45	23	09	-08
3	53	-70	-05	-10	13	-15
4	65	-10	51	06	06	25
5	59	-06	60	24	-28	05
6	05	20	-47	-47	23	09
7	-07	36	-28	-35	-15	24
8	09	35	-53	28	07	26
9	40	06	-02	11	-28	30
10	60	33	-05	35	-12	-22
11	40	-09	42	-35	25	10
12	37	26	20	-22	36	-26
13	54	-05	-18	-45	-27	-11
14	71	-33	-30	-06	-06	31
15	08	-12	23	19	58	34
16	-18	-73	-33	32	06	-15
17	73	36	-38	19	20	-13
18	64	-42	-06	-25	-12	-17

Note.-Decimal places have been omitted.

Table 18

Unrotated Principal Axes Factor Solution
for the Physostigmine Condition

	Factor					
Variable	I	II	III	IV	V	VI
1	14	-38	34	-57	35	10
2	50	-53	-32	-20	-20	-10
3	44	38	-49	-34	18	17
4	69	-30	38	-06	09	08
5	54	-16	49	31	-23	-16
6	-46	-52	-05	38	23	33
7	02	-60	-25	38	-18	28
8	26	-24	-60	28	12	-22
9	46	61	08	11	16	12
10	-44	-42	-14	-27	-02	16
11	42	-28	50	35	-05	19
12	-02	-11	10	-08	03	31
13	28	60	35	31	16	10
14	78	06	-08	14	00	15
15	31	-28	-21	16	50	-18
16	32	-30	46	-56	-12	-03
17	60	-51	-49	-03	-03	-08
18	36	58	-53	-17	-24	25

Note.-Decimal places have been omitted.

Table 19

Unrotated Principal Axes Factor Solution for the Chlorpromazine Condition

	Factor					
Variable	I	II	III	IV	V	VI
1	03	39	-04	44	-37	-16
2	-81	-11	09	20	31	-24
3	-32	05	-67	14	-21	09
4	-37	70	08	-02	15	-06
5	-12	68	20	-28	34	14
6	-44	-23	66	-11	-29	24
7	-50	-38	04	-32	-10	06
8	-28	-19	68	26	-26	15
9	-24	41	06	12	26	17
10	41	49	21	31	06	-06
11	-41	48	05	-51	-14	16
12	-02	38	12	-31	-13	-37
13	-72	-05	00	41	-07	-30
14	-46	12	-44	-11	-21	-13
15	10	31	-02	55	04	29
16	03	53	20	-02	-49	-17
17	-91	-08	10	15	25	03
18	-58	15	-44	-02	-20	34

Note.-Decimal places have been omitted.

Table 20

Unrotated Principal Axes Factor Solution
for the Dexedrine Condition

	Factor					
Variable	I	II	III	IV	V	VI
1	14	-59	08	09	19	32
2	52	38	56	-10	-30	-22
3	66	06	-39	14	-49	-07
4	49	24	-14	-12	56	-19
5	65	15	04	-15	35	13
6	-19	57	15	-13	-06	38
7	-23	24	21	-57	-16	24
8	-63	40	-06	07	02	13
9	60	02	05	41	03	32
10	-07	38	15	58	20	11
11	64	37	-17	-29	16	21
12	09	17	04	-23	42	-11
13	40	-46	33	-03	13	-19
14	50	-34	03	-17	-23	36
15	-11	29	-30	40	10	19
16	38	-47	36	20	-02	05
17	34	67	50	24	-11	-12
18	63	24	-58	-05	-18	-19

Note.-Decimal places have been omitted.

Table 21

Final Transformation Matrix
for the Normal Condition

	A	B	C	D	E	F
I	49	08	30	10	55	27
II	52	07	-05	30	-70	14
III	27	-19	-79	-28	09	08
IV	-06	-13	-19	87	36	26
V	41	-84	41	15	09	-39
VI	50	48	-28	19	24	-82

Note.-Decimal places have been omitted.

Table 22

Matrix of Cosines of Reference Vectors
for the Normal Condition

	A	B	C	D	E	F
A	1.00					
B	- .07	1.00				
C	- .05	- .28	1.00			
D	.23	- .07	.08	.99		
E	.07	- .03	.03	.19	1.00	
F	- .36	- .08	.03	.06	- .08	.00

Table 23

Final Transformation Matrix
for the Placebo Condition

	A	B	C	D	E	F
I	41	-08	34	29	38	-01
II	11	-63	-05	-07	-63	-36
III	-40	-18	84	-26	25	36
IV	-65	-30	-19	68	03	06
V	27	-69	-35	-41	63	16
VI	40	05	10	46	-02	84

Note.-Decimal places have been omitted.

Table 24

Matrix of Cosines of Reference Vectors
for the Placebo Condition

	A	B	C	D	E	F
A	1.00					
B	.00	1.00				
C	- .13	.16	.99			
D	- .15	.17	- .06	1.00		
E	.13	- .12	.14	- .16	1.00	
F	.15	.08	.33	.29	.40	.99

Table 25

Final Transformation Matrix
for the Atropine Condition

	A	B	C	D	E	F
I	47	-01	29	48	08	-05
II	37	-82	-09	-25	-05	-14
III	-53	-22	52	-04	23	-34
IV	55	41	57	-71	04	20
V	20	00	-54	-14	76	-47
VI	-15	-33	16	41	60	77

Note.-Decimal places have been omitted

Table 26

Matrix of Cosines of Reference Vectors
for the Atropine Condition

	A	B	C	D	E	F
A	1.00					
B	.08	1.00				
C	.00	.14	1.00			
D	- .33	- .22	- .12	.99		
E	- .02	- .19	- .14	.15	1.00	
F	.10	.02	.31	.26	.04	.99

Table 27

Final Transformation Matrix
for the Physostigmine Condition

	A	B	C	D	E	F
I	65	14	30	20	13	02
II	14	-58	38	-06	-08	-24
III	46	-46	-29	44	-14	04
IV	53	-17	-10	-82	-17	33
V	04	-62	21	30	95	12
VI	26	-14	79	-02	17	90

Note.-Decimal places have been omitted.

Table 28

Matrix of Cosines of Reference Vectors
for the Physostigmine Condition

	A	B	C	D	E	F
A	1.00					
B	- .35	1.00				
C	.28	- .27	1.00			
D	- .10	- 118	.04	1.00		
E	- .01	- .46	.40	.39	1.00	
F	.41	- .13	.61	- .22	.23	.99

Table 29

Final Transformation Matrix
for the Chlorpromazine Condition

	A	B	C	D	E	F
I	-52	-23	-18	15	-06	-35
II	02	79	-20	41	31	03
III	07	17	66	11	-02	-51
IV	40	-49	05	72	24	-23
V	41	23	-49	17	-64	-42
VI	-63	03	51	50	-65	62

Note.-Decimal places have been omitted.

Table 30

Matrix of Cosines of Reference Vectors
for the Chlorpromazine Condition

	A	B	C	D	E	F
A	1.00					
B	.03	1.00				
C	- .37	- .13	1.01			
D	- .02	.01	.17	1.00		
E	.28	- .03	- .07	- .15	1.00	
F	- .51	.05	.23	- .02	.14	1.00

Table 31

Final Transformation Matrix
for the Dexedrine Condition

	A	B	C	D	E	F
I	53	42	19	06	34	25
II	06	-70	56	18	29	06
III	-63	44	67	-04	-21	08
IV	27	32	-12	87	-38	-33
V	-50	17	-38	18	78	00
VI	07	12	-22	42	-05	91

Note.-Decimal places have been omitted.

Table 32

Matrix of Cosines of Reference Vectors
for the Dexedrine Condition

	A	B	C	D	E	F
A	1.01					
B	- .09	1.01				
C	- .15	- .15	1.00			
D	.24	.24	- .18	1.00		
E	- .17	- .15	- .15	- .13	1.00	
F	.06	.10	- .03	.12	.17	1.01

Table 33

Final Rotated Oblique Factor Solution for the Normal Condition

Variables	A	B	C	D	E	F
1	-09	54	03	-10	01	-26
2	03	11	35	-02	76	-02
3	04	13	81	-03	02	-18
4	72	-07	29	-04	-04	-02
5	53	-09	-09	-05	-10	40
6	05	-40	-02	-15	52	10
7	02	-08	-05	-08	67	-14
8	-14	-26	26	29	54	-30
9	49	02	-14	65	17	24
10	64	-09	07	33	-02	-23
11	67	13	-10	01	09	-09
12	08	-07	-03	-64	-11	-04
13	26	27	05	40	64	17
14	-11	-17	16	45	-10	49
15	26	-12	29	52	-25	-16
16	00	60	-10	11	-05	32
17	00	04	13	-12	70	40
18	02	-01	78	01	01	30

Note.-Decimal places have been omitted.

Table 34

Final Rotated Oblique Factor Solution
for the Placebo Condition

Variables	A	B	C	D	E	F
1	48	-11	15	-10	66	02
2	03	33	54	07	69	56
3	83	00	-02	05	-13	02
4	26	-07	02	66	13	06
5	04	22	12	60	14	-10
6	-44	-01	62	14	-04	-03
7	-07	03	75	02	-06	-03
8	-08	-26	09	00	-19	51
9	-12	05	-26	33	44	42
10	-11	-31	-07	03	44	-13
11	-12	-04	00	77	-19	-01
12	11	-66	-15	11	-08	-02
13	02	71	-24	-03	-09	-16
14	00	69	-01	10	07	36
15	-08	14	-13	31	03	25
16	54	03	-02	05	51	-04
17	00	-02	69	-07	67	56
18	67	-01	39	-09	-03	-03

Note.-Decimal places have been omitted.

Table 35

Final Rotated Oblique Factor Solution for the Atropine Condition

Variables	A	B	C	D	E	F
1	-23	71	-16	17	05	36
2	82	10	05	15	-02	04
3	01	59	04	42	07	-11
4	01	-09	50	37	37	-02
5	01	-01	78	16	01	-01
6	12	-28	-63	33	10	00
7	-01	-46	-28	26	-07	23
8	58	-14	-12	-17	09	35
9	18	-10	36	26	-01	36
10	63	-04	35	-11	-19	-10
11	-23	-20	02	45	36	-26
12	15	-27	-17	10	17	-54
13	05	-07	-06	59	-29	-01
14	28	20	13	61	14	37
15	04	01	00	-02	72	-04
16	03	85	-03	-19	-09	14
17	84	-10	-04	06	04	-11
18	04	30	09	54	-15	-08

Note.-Decimal places have been omitted.

Table 36

Final Rotated Oblique Factor Solution
for the Physostigmine Condition

Variables	A	B	C	D	E	F
1	-07	-05	01	77	44	05
2	-03	70	-06	10	-02	-05
3	-01	-01	63	18	35	-04
4	57	04	07	40	16	16
5	66	06	-25	01	-29	00
6	-10	01	-05	-33	20	56
7	08	47	00	-44	-07	49
8	-04	36	-01	-39	17	-05
9	52	-46	47	04	15	03
10	-51	28	-10	09	06	14
11	70	-06	-02	02	-07	37
12	06	-03	18	12	08	29
13	63	-64	29	-04	05	09
14	59	07	38	-01	10	18
15	12	-01	-01	01	51	01
16	07	18	-14	71	-03	-13
17	06	64	06	-04	15	03
18	04	10	65	-13	-09	-01

Note.-Decimal places have been omitted.

Table 37

Final Rotated Oblique Factor Solution
for the Chlorpromazine Condition

Variables	A	B	C	D	E	F
1	11	-01	01	33	57	-02
2	78	08	-04	-04	02	-09
3	03	-11	-24	00	16	57
4	30	69	-13	23	17	01
5	03	82	-09	21	-17	-08
6	-04	03	82	-10	-05	11
7	05	-04	26	-45	-14	29
8	09	-15	75	17	08	-12
9	19	39	-03	36	-11	03
10	-02	18	-08	49	20	-37
11	-14	71	14	-17	04	41
12	09	44	-13	-26	37	-15
13	69	-10	04	00	37	00
14	16	13	-20	-25	27	42
15	00	-03	06	69	01	02
16	-09	34	17	06	58	01
17	62	15	15	00	-12	15
18	-03	15	05	05	-01	73

Note.-Decimal places have been omitted.

Table 38

Final Rotated Oblique Factor Solution
for the Dexedrine Condition

Variables	A	B	C	D	E	F
1	-06	61	-41	15	-04	27
2	05	09	86	-16	-02	03
3	88	02	09	07	-11	03
4	04	01	-02	-01	76	-01
5	12	21	09	05	58	34
6	-14	-42	34	12	05	39
7	-29	-36	31	-40	03	38
8	-25	-53	02	16	-10	-04
9	40	44	03	53	05	31
10	-05	01	13	64	-02	-07
11	32	-10	14	-02	59	46
12	-24	-08	03	-14	49	01
13	-11	62	03	-15	06	-07
14	32	41	-04	-07	-07	49
15	22	-21	-19	50	03	01
16	01	72	02	12	-18	08
17	02	-06	81	26	03	-03
18	78	-23	-02	-05	29	-03

Note.-Decimal places have been omitted.

Table 39

Means for All Variables
in the Six Conditions

Variables	Conditions					
	Normal	Placebo	Atropine	Dexedrine	Physos-tigmine	Chlor-promazine
1	1.90	1.60	2.00	1.75	1.75	1.70
2	5.25	4.45	4.55	4.25	3.85	4.15
3	2.70	2.80	2.10	2.45	2.35	2.35
4	32.70	29.55	30.30	28.90	27.75	30.55
5	38.10	34.60	34.75	39.00	35.40	34.20
6	12.30	12.00	12.35	13.05	12.30	12.05
7	11.60	11.90	12.05	12.15	12.15	12.55
8	10.55	10.60	10.40	11.00	11.20	10.90
9	4.35	4.65	4.50	4.60	4.55	4.75
10	5.45	5.60	5.25	5.95	5.70	5.35
11	24.15	24.35	24.60	25.05	27.80	23.65
12	11.00	10.90	10.80	10.80	10.65	11.10
13	103.45	101.90	98.40	105.95	123.50	101.55
14.	97.65	109.85	109.80	102.80	106.35	105.10
15	7.00	6.75	6.65	7.10	6.70	6.85
16	91.90	92.55	89.00	86.90	86.45	92.70
17	147.60	164.80	158.20	165.10	169.50	146.45
18	30.10	26.40	31.00	30.85	31.45	33.95

Table 40

Standard Deviations for All Variables
in the Six Conditions

Variables	Conditions					
	Normal	Placebo	Atropine	Dexedrine	Physostig-mine	Chlorpro-mazine
1	1.02	1.39	1.38	0.79	1.29	1.13
2	2.29	1.85	2.60	2.63	2.35	2.28
3	0.92	0.83	0.72	0.94	0.88	0.88
4	19.24	16.58	19.59	14.46	14.66	17.86
5	22.10	18.10	20.30	24.83	20.18	20.48
6	5.06	482	4.77	4.06	4.35	5.49
7	3.56	2.90	3.78	3.44	4.80	3.02
8	2.16	2.37	1.76	1.86	2.31	1.80
9	1.66	1.27	1.43	1.19	1.32	1.34
10	1.85	1.54	1.68	1.23	1.13	1.60
11	12.28	14.99	14.58	14.31	16.21	14.52
12	2.27	2.67	2.28	2.19	2.32	2.47
13	66.39	61.44	72.29	82.54	99.62	94.20
14	25.04	28.30	29.09	32.34	24.53	30.55
15	1.26	1.52	1.42	1.21	1.34	1.50
16	26.16	38.27	24.36	25.40	36.04	21.61
17	63.82	42.64	82.82	56.68	59.82	68.17
18	21.42	20.88	17.78	21.67	21.04	14.96

APPROVAL SHEET

The dissertation submitted by Mary Kay Snyder has been read and approved by a board of five members of the Department of Psychology.

The final copies have been examined by the director of the dissertation and the signature which below verifies the fact that any necessary changes have been incorporated, and that the dissertation is now given final approval with reference to content, form, and mechanical accuracy.

The dissertation is therefore accepted in partial fulfillment of the requirements for the Degree of Doctor of Philosophy.

Aug 27/66
Date

Signature of Advisor