CONVERGENT-THINKING IN SCHIZOPHRENIC PATIENTS

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CURRICULUM STUDIORUM

Gerald Sperrazzo was born on December 16, 1931, in New York City. He received his Bachelor of Arts degree from the University of Idaho, Moscow, Idaho, in 1953. He received a Master of Arts degree in Psychology from St. Louis University, St. Louis, Missouri, in 1956. The title of his thesis was A Study of the Validity of the Colored Progressive Matrices Test (1947), Sets A, Ab, B.

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INTRODUCTION

There have been a number of various approaches to the problem of schizophrenic thinking. The traditional approaches to this area of investigation have been to study a single dimension of the response patterns of schizophrenics. These pursuits have indicated that schizophrenics differ along a single dimension of cognitive functioning which may be characteristic of the disorder. Other investigators have concluded that schizophrenic cognitive processes are essentially different from those of a normal adult individual.

The purpose of this investigation, therefore, is to determine whether schizophrenic cognitive functioning differs from normal cognitive processes in kind, or in degree, using a multidimensional, factor-analytic approach.

The first chapter of this thesis is concerned with the review of the literature of the various approaches to the problem of schizophrenic thinking. This is followed by an explanation of Guilford's theory of the Structure of Intellect which is the basis for the multidimensional approach to the problem. Following this presentation, the basic hypotheses to be tested in this investigation are stated.

The second chapter presents the experimental design of the investigation. It describes the instruments and how they were used, the population involved, and the statistical method for handling the data.

The third chapter presents the results and a discussion of their implications. Suggestions for subsequent research are indicated in this section.

CHAPTER I

REVIEW OF THE LITERATURE

This chapter has been divided into three parts. The first part will report the findings of the review of the literature of the traditional schools of thought who regard the basis of schizophrenic thinking to be unidimensional or, in other words, who account for and explain the totality of schizophrenic functioning in terms of a single variable. The second part will deal with a multidimensional approach to thinking functions in which Guilford's Structure of the Intellect Theory will be presented. This will lead into the third part which will introduce the statement of the hypotheses.

1. Traditional Approaches to Schizophrenic Thinking.

The earliest work of this nature was centered about the dimension of concrete versus abstract behavior in schizophrenics. The experimental research of this kind was initiated by Vigotsky[1] who experimented with schizophrenic patients on a task of abstraction and concluded "(...) that

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1 L. Vigotsky, "Thought in Schizophrenia", in Archives of Neurology and Psychiatry, Vol. 31, No. 5, 1934, p. 1063-1077.

the most important deterioration of thought occurring in schizophrenia is a disturbance, or impairment in the function of formation of a concept".[2] He observed that the schizophrenic patients demonstrated a reduction of conceptual thinking comparable in kind to that of patients with cerebral lesions. This similarity led to the inference that the disturbance in concept formation in schizophrenia was caused by an underlying organic process.

Bychowski[3] found similar results and also suggested that the thought processes in schizophrenics were characteristic of patients with organic pathology. This finding was again confirmed by Kasanin and Hanfmann[4] who administered the Vigotsky blocks to fifty schizophrenic patients and forty-five controls and found definite impairment in conceptual thought.

Bolles and Goldstein[5] followed the same trend of research but enlarged upon the concept of abstract thought.

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2 Vigotsky, Op. Cit., p. 1065.

3 G. Bychowski, "Certain Problems of Schizophrenia in the Light of Cerebral Pathology", in Journal of Nervous and Mental Disorders, Vol. 81, No. 3, 1935, p. 280-298.

4 J. Kasanin and E. Hanfmann, "An Experimental Study of Concept Formation in Schizophrenia", in American Journal of Psychiatry, Vol. 95, No. 1, 1938, p. 35-48.

5 M.M. Bolles and K. Goldstein, "A Study of the Impairment of 'Abstract Behavior' in Schizophrenic Patients", in The Psychiatric Quarterly, Vol. 12, No. 1, 1938, p. 42-65.

After administering a battery of sorting tests to sixteen schizophrenics, these authors concluded, "(...) the characteristic defect of schizophrenic patients studied was an impairment of the capacity for the type of behavior we call 'abstract behavior'".[6] Their view was that the basic disorder was more generalized to the total behavior of the individual than specific only to the thought processes. This position was eventually expanded by Goldstein and Scheerer[7] to account for the total behavioral aspects of pathological and normal functioning. It is their thesis that abstract and concrete attitudes are "capacity levels of the total personality".[8] They consider these capacity levels as basic to all performance and, that a normal individual can assume both the concrete and the abstract attitude whereas the abnormal person is able to assume only the concrete type of behavior. They continue to describe eight conditions which specify abstract behavior and indicate that this kind of behavior represents a new functional level which is associated with the frontal lobes of the cerebral cortex.

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6 Bolles and Goldstein, Op. Cit., p. 65.

7 Kurt Goldstein and Martin Scheerer, "Abstract and Concrete Behavior An Experimental Study with Special Tests", in Psychological Monographs, Vol. 53, No. 2, 1941, 1-151 p.

8 Ibid., p. 1.

The area of concrete thinking in schizophrenics supplied considerable impetus for numerous studies which are adequately reviewed by Payne[9] who concluded:

> There is no evidence that schizophrenics or any other functional psychotic groups are abnormally concrete, or unable to form new concepts, although elderly demented patients are concrete in this sense.[10]

He concluded this after determining that those investigations which supported the concrete versus abstract behavior dichotomy were often studies which were completely uncontrolled and equivocal in the sense that the results could have occurred in groups other than schizophrenics as it did in Fisher's[11] study. In this study, Fisher found that there was no difference between schizophrenic and hysterics with respect to concreteness but that both groups were more concrete than a normal control group.

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9 R.W. Payne, "Cognitive Abnormalities", in H.J. Eysenck, Handbook of Abnormal Psychology, An Experimental Approach, New York, Basic Books, 1961, p. 193-261.

10 Ibid., p. 250.

11 S. Fisher, "Patterns of Personality Rigidity and Some of Their Determinants", in Psychological Monographs, Vol. 64, No. 1, 1950, 111-48 p.

The present state of research in the area of concrete versus abstract behavior then, is questionable in light of inadequate experimentation. However, it is not unlikely that such a phenomenon may emerge in an experiment where adequate controls are established since it has been so consistently reported in studies which are qualitative in nature.

The second approach to schizophrenic thought can be classed under the term "overinclusive thinking" which has been demonstrated to exist in schizophrenic patients. The hypothesis of overinclusive thinking in schizophrenia was first introduced by Cameron[12] who regards this concept as the inability to perceive conceptual boundaries. He became aware of this phenomenon in a study in which he administered the Vigotsky blocks to five severely disorganized schizophrenics and six senile patients. From a qualitative analysis of the results, he concluded that:

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12 N. Cameron, "Deterioration and Regression in Schizophrenic Thinking", in Journal of Abnormal and Social Psychology, Vol. 34, No. 2, 1939, p. 265-270.

> The single most striking characteristic of our schizophrenic patient's attempt at solutions was their inability to maintain adequate boundaries. Faced with this definite, arbitrary task they could neither restrict themselves to its limits, nor keep other material from intruding. The immediate perceptual field, the patient's thinking about absent things and events, material derived from his personal preoccupation --- all might become worked into the problem itself, and so inextricably so as to make the solution depend upon extraneous conditions that could not possibly be confined to a single frame of reference.[13]

The phenomenon of overinclusiveness was subsequently investigated by a considerable number of researchers who are reviewed by Payne.[14] After reviewing these works, Payne concluded that "these studies produce remarkably consistent results, which support the hypothesis that schizophrenics display abnormal overinclusion in their concept formation".[15]

A third approach to thought disorders in schizophrenia is the "regression" hypothesis of the psychoanalytic school. This position is most clearly presented by Finichel[16] who postulates that schizophrenic thought is an archaic way of thinking which is due to a regression from the logical to the pre-logical level of thought. It is assumed that the pre-logical level of functioning is effective in the unconscious portion of the normal adult mind while in schizophrenia, the

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13 Cameron, Op.Cit., p. 267.

14 Payne, Op. Cit., p. 244-250.

15 Ibid., p. 246.

16 Otto Finichel, The Psychoanalytic Theory of Neurosis, New York, Basic Books, 1945, v-703 p.

unconscious part of the person becomes conscious and reveals itself in a disorganized archaic fashion. It is explained that in schizophrenia, the ego becomes overwhelmed by intense instinctual demands which bring about a regression of the personality to a lower level of functioning in order to defend against these undesirable instinctual urges. Hence, the individual allows himself to fall into the abyss of infantile sexual fantasies as a defence against the perceived threats of reality.

Arieti[17] concurs with the regression hypothesis but interprets it in more explicit terms. He states:

> This regression occurs so often that this process can be defined in the form of a principle. If, in a situation of severe anxiety, behavior at a certain level of integration cannot take place or does not bring about the desired results, a strong tendency exists toward behavior of lower levels of integration in order to effect these results.[18]

There is little experimentation to either support or negate the "regression" hypothesis of the psychoanalytic school and it would indeed be difficult to attempt any systematic investigation of such processes since this phenomenon is entirely qualitative and oftentimes equivocal.

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17 Silvano Arieti, Interpretation of Schizophrenia, New York, Robert Brunner, 1955, vii-522 p.

18 Ibid., p. 191.

Nevertheless, this school of thought is presented here since it does constitute one hypothesis for the explanation of schizophrenic thought processes.

The fourth approach to be presented is a relatively new one which purports to account for intellectual abilities in problem-solving behavior in both normal and abnormal cognitive processes. In 1960, Fourneaux[19] proposed a rather complex mathematical model which developed out of an attempt to determine the factors which constitute a score on intelligence tests. His basic thesis is that a score which an individual receives on a given test describes the behavior incompletely because the score itself is merely summarizing the emergence of a complex process. He holds that when one variable is combined with another variable, the resultant is an emergence of a new function which is distinct from either of the original variables. He calls then for two processes in the assessment of intellectual functioning. First, it would be necessary to dissect variables into their subcategories until one reaches the point at which each variable measures only a small portion of the total variance produced by the behavior of an individual. Second, that these

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19 W.D. Fourneaux," Intellectual Abilities and Problem-Solving Behavior", in H.J. Eysenck, Handbook of Abnormal Psychology An Experimental Approach, New York, Basic Books, 1961, p. 167-192.

variables be systematically combined so that their interaction effect will produce an emergent function which can be quantified and relatable to behavior. He continues to explain that since determinants of behavior are not in themselves isolated but rather interact with other variables, then the measurement and assessment of intellectual abilities must take into account the emergent function which is most characteristic of behavior. With respect to problem-solving, he suggests that three attributes must be taken into account; namely, speed, accuracy, and continuance, in order to accurately assess intelligent problem-solving behavior.

It is interesting to note that in this presentation, Fourneaux was able to reach a rapprochment between the atomistic and field theorists. However, it seems that the problem of the identification of significant variables related to cognitive functioning still remains whether they be primary or secondary. At this point it is difficult to determine the specific value of this emergence hypothesis since there has been little experimentation with it, and virtually no reports of its applicability with respect to pathological cognitive functioning.

The fifth approach may be grouped under the heading "psychometric and factor-analytic studies". Only those investigations which are directly related to schizophrenic thinking will be mentioned in this section.

Wilkins[20] performed a study which compared one hundred schizophrenic patients and one hundred normals in order to determine if there was a schizophrenic pattern on the Primary Mental Abilities Test. Although no pattern emerged which discriminated the two populations reliably, the study revealed that the schizophrenics performed significantly lower than normals on every factor of the test. These results would suggest that perhaps schizophrenic functioning demonstrates a generalized rather than a differential deficit.

Simkin,[21] however, found quite the reverse when he factor-analyzed the Wechsler-Bellevue Intelligence Scale for a normal and a schizophrenic population. He found that in the normal population, virtually all of the sub-tests loaded on what appeared to be a "G" factor while the schizophrenic population yielded less loadings on the "G" factor and more on the other independent factors. He states the following:

> It is concluded that there are differences in the intellectual structure of normal adults and schizophrenics matched for age and education. The intellectual structure of the schizophrenic group appears to be relatively differentiated as contrasted with that of the normal group which appears to be relatively integrated.[22]

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20 Muriel Wilkins, Is There a Schizophrenic Pattern on the P.M.A.?, unpublished Masters Thesis presented to the School of Psychology and Education of the University of Ottawa, Ontario, 1959, vii-75 p.

21 J.S. Simkin, "An Investigation of Differences in Intellectual Factors Between Normal and Schizophrenic Adults", Microfilm Abstracts, Vol. 11, No. 2, 1951, p. 448-449.

22 Ibid., p. 449.

There is evidence that schizophrenics differ from other groups of varying pathology with respect to their ability to function on a test of intelligence. This was pointed out by Cohen[23] after factor-analyzing the Wechsler-Bellevue Intelligence Scale results of one hundred neurotics, 111 schizophrenics and sixty-six organics. Three factors were found in all groups, however, the factor loadings on each factor varied for the three groups. Cohen states:

> It has been pointed out that some of the subtests load on a given factor in some groups, and fail to do so in some other. This is suggestive of certain basic differences in the nature of intellectual functioning under the varying conditions of psychopathology.[24]

These studies, then, would suggest that the deficit in schizophrenic thinking is not global but differentiated and that a basic difference seems to exist between schizophrenic and normal intellectual functioning.

The review of the traditional approaches to cognitive functioning leads to the conclusion that there is no comprehensive theory of normal or abnormal cognitive functioning. These approaches have provided, in some cases, a single

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23 J. Cohen, "Factors Underlying Wechsler-Bellevue Performance of Three Neuropsychiatric Groups", in Journal of Abnormal and Social Psychology, Vol. 47, No. 2, 1952, p. 359-365.

24 Ibid., p. 364.

dimension of the abnormal thought process which is verifiable and characteristic of the pathology as in the case of the "overinclusion" phenomenon. However, it is clear that we cannot assume that one function or process is the sine qua non of all thought. Thinking is, indeed, complex and varies with the specific task involved, the material with which one must operate and the kind of conclusion that must emerge. All of these factors then, must be taken into consideration if a general theory of thinking is to be applicable to the normal adult mind.

In the following section, such a theory will be presented. Guilford's theory of the Structure of Intellect will be introduced and reference will be made of its applicability to pathological thought processes.

2. Guilford's Theory of the Structure of Intellect.

In 1956, Guilford[25] published an article in which he proposed his theory of the structure of the intellect. With the exception of Guilford's own revision[26] of his earlier formulation, no further research has been published on this subject.

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25 J.P. Guilford, "The Structure of Intellect", in Psychological Bulletin, Vol. 53, No. 4, 1956, p. 267-293.

26 --------, "A Revised Structure of Intellect", in Reports from the Psychological Laboratory, The University of Southern California, No. 19, 1957, 27 p.

In the opening lines of his earlier publication, Guilford states: "It is the purpose of this report to describe a developing picture of the structure of the human adult intellect, as seen in terms of factors".[27] By means of factor analysis, forty-six factors of the intellect have been identified. A summary of these factors is shown in Figure 1. An inspection of Figure 1 reveals that these factors were divided into two broad categories; namely, thinking and memory. Within the group of thinking factors, a threefold division is made into a segment called cognitive factors, productive factors, and evaluative factors. One further subdivision is made with respect to the productive factors. It is separated into two classes of thinking abilities labelled convergent-thinking and divergent-thinking abilities.

With respect to the meaning of the cognitive factors, Guilford states that:

> (...) the cognitive factors have to do with becoming aware of mental items or constructs of one kind or another. In tests of those factors, something must be comprehended, recognized, or discovered by the examinee. They represent functions on the receiving side of the behavior sequence.[28]

Productive factors are represented by those tests in which the subject is required to do something after he has

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27 Guilford, "The Structure of Intellect", Op. Cit., p. 267.

28 Ibid., p. 268-269.

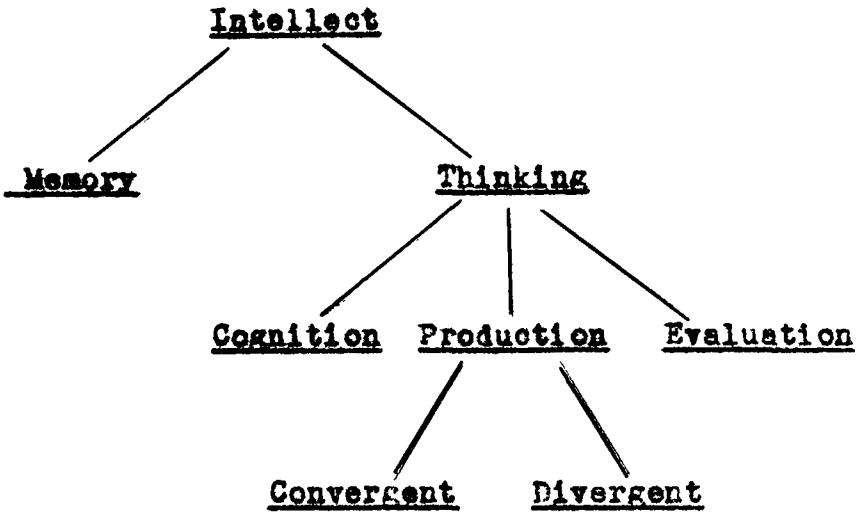

Figure 1 Diagram of the Major Categories of Intellectual Factors and Their Logical Relationships.[a]

a J.P. Guilford, "Creative Abilities in the Arts", in Psychological Review, Vol. 64, No. 2, 1957, p. 111.

understood a situation. Convergent-thinking involves a solution of a problem in which there is "almost always one conclusion or answer that is unique, and thinking is channeled or controlled in the direction of that answer".[29] Conversely, divergent-thinking involves activity in which "there is much searching or going off in various directions. This is most clearly seen when there is no unique conclusion".[30] The last of the triparte division of thinking involves those factors identified as the evaluation factors. These factors

> (...) have to do with decisions concerning the goodness, suitability or effectiveness of the results of thinking. After a discovery is achieved, is it correct, is it the best we can do, will it work? This calls for a judgemental step of some kind.[31]

Since this investigation will be primarily concerned with the convergent-thinking factors, a further explanation of this area will be presented next.

Illustrated in Table I is a schematic representation of the convergent-thinking factors. It will be noticed that the rows represent the type of result that is produced by the subject and the columns indicate the type of content with which the subject must work. The content of the stimulus has

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29 Guilford, "The Structure of Intellect", Op. Cit., p. 274.

30 Ibid., p. 274.

31 Ibid., p. 281.

Table I.-

Convergent-Thinking Factors.[a]

Type of Results Produced	Type of Content		
	Figural	Structural	Conceptual
Names	Object Naming		Concept Naming
Correlates		Eduction of Structural Correlates	Eduction of Conceptual Correlates
Orders			Ordering
Transformations	Visualization	Structural Redefinition	Conceptual Redefinition
Unique Conclusions	Symbol Substitution	Numerical Facility	

a J.P. Guilford, "A Revised Structure of Intellect", in Reports from the Psychological Laboratory, The University of Southern California, April, 1957, No. 19, p. 14.

been designated as figural, where perceived form is essential; conceptual, where verbal concepts form the basis of the operation; and, structural, where neither perceived form nor verbal meaning is essential but, rather, where the relationship between the series of stimuli is the essential characteristic. This would be best represented by tests which have letters or numbers arranged in a special sequence to illustrate relationships between the proximate stimuli.

Within the cells of Table I are the names of the ten convergent-thinking factors that have been discovered up to date. Some cells have no factors in them as yet. However, Guilford hypothesizes that these factors do exist and that they can be found by continued factor-analytic research.

What Guilford has proposed then, is a cognitive theory of the intellect and its function based upon factors derived from the nature of the stimulus. If this model can be assumed to represent the intellect and its varied activities, could the question not be asked, "To what extent are these functions affected, if they are affected at all, by disturbances in the personality structure of the individual?" In other words, "How does pathology affect intellectual functions and what is the nature of this effect?"

Guilford has made some speculations of the effect of pathology on his factors. He states:

> There are many possible relationships of the intellectual factors to pathology. Defects in memory and thinking are common occurrences in connection with intellectual losses that are associated with organic and functional pathologies. If we find by observation and experimental study that defects tend to be along the line of intellectual factors, we have another source of evidence for the validity of the factors as functional unities. In practice, the use of the measures of the factors may be helpful in providing more accurate and meaningful assessment of intellectual losses. Losses described in terms of factor concepts may help in understanding the types of pathology, and in providing better definitions and diagnostic criteria.[33]

3. Statement of the Hypotheses.

This investigation, therefore, will attempt to relate schizophrenic functioning in terms of Guilford's theory of the Structure of Intellect. In doing this, two central questions emerge thereof. First, are the factors which describe the thinking functions of normal subjects the same as those in schizophrenic subjects? Second, do schizophrenic patients perform as well as normals on these functions? Restated in null form, the hypotheses of this investigation are as follows:

1. There is no significant difference between the dimension accounting for the variance of the convergent-thinking activity of schizophrenic and normal subjects.

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33 Guilford, "The Structure of Intellect", Op. Cit., p. 290.

2. There is no significant difference between the performance of the schizophrenic and normal subjects on any of the convergent-thinking tests.

This chapter presented a review of the literature on schizophrenic thinking and introduced Guilford's theory of the Structure of Intellect. This was followed by the basic hypotheses of this investigation.

The next chapter will describe the experimental design of this investigation.

CHAPTER II

EXPERIMENTAL DESIGN

This chapter describes the experimental design of this investigation. It is divided into four parts. In the first part, the convergent-thinking tests are presented along with a description of the factors which they represent. The method of administration is presented in the second section, while the third part describes the populations used in this investigation. The fourth section presents the statistical procedure for handling the data.

1. Tests of Convergent-Thinking.

Ten tests were used in this investigation. These were selected from a larger group of tests which produced the highest factor loadings for each factor. A copy of each test has been placed in Appendix 1. The only test omitted from Appendix 1 is the Form-Naming Test which is an individually administered test. This test will be described subsequently. The scoring systems for each test can be found in Appendix 2. The test-retest reliabilities, the factor loadings, and the originator of each test are shown in Appendix 3.

A brief description of each test and the factor which it best represents follows:

1. Camouflaged Words.- In this test, the subject is asked to find the name of a sport or a game that is concealed in a sentence. This test has a high factor loading on the factor named Structural Redefinition, which is defined as: "The ability to reorganize elements in terms of the structural properties of material, assigning a new function or use to the elements involved."[1]

2. Correlate Completion II.- The subject is instructed to find a word that bears the same relationship to a given word that is indicated by several stimulus pairs of words. The relationship is based only on the word structure. This test loads on Eduction of Structural Correlates which is: "The ability to find a (non-verbal) response to fulfill a given relationship."[2]

3. Form Naming.- This is the only individually administered test in the battery. This test was originally constructed by Woodworth[3] and a copy of it can be found in his article. The Form Naming test consists of five geometrical figures randomly assigned to a matrix of ten rows and ten

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1 J.P. Guilford, "A Revised Structure of Intellect", in Reports from the Psychological Laboratory, The University of Southern California, 1957, No. 19, p. 27.

2. Ibid., p. 23.

3 R.S. Woodworth and F.L. Wells, "Association Tests", in Psychological Monographs, Vol. 13, No. 57, 1911, 1-85 p.

columns. These figures are: a circle, square, triangle, cross, and star. The subject is asked to identify these figures as quickly as possible by naming them. The Form Naming test represents a factor called Object Naming, which has been reported by French[4] and is defined by Guilford as: "The facility in thinking of common names for meaningful stimuli".[5]

4. Inventive Opposites.- In this test, the subject is asked to write two antonyms for a given word, the first letters of the antonyms being given. This test represents Eduction of Conceptual Correlates which is described as: "The ability to produce a response to fit a given or implied conceptual relationship."[6]

5. Numerical Operations, Part III.- This test is that part of the Guilford-Zimmerman Aptitude Survey which requires the subject to solve simple problems of addition, subtraction, and multiplication. The factor it best represents is Numerical Facility which is defined as: "The ability to manipulate numbers rapidly."[7]

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4 J.W. French, "The Description of Aptitude and Achievement Tests in Terms of Rotated Factors", in Psychometric Monographs, Vol. 23, No. 5, 1951, v-278 p.

5 Guilford, Op. Cit., p. 25.

6 Ibid., p. 23.

7 Ibid., p. 25.

6. Object Synthesis.- This is a test in which the subject is asked to make a new object by combining two given objects. It represents the factor named Conceptual Redefinition which is defined as: "The ability to shift the function of an object or part of an object and use it in a new way."[8]

7. Punched Holes.- The subject is required to indicate a pattern of holes in an unfolded piece of paper which was punched while folded. The factor named Visualization is represented by this test. It is defined as: "The ability to manipulate or transform an object into another visual arrangement."[9]

8. Sentence Order.- This test requires that the individual arrange three sentences in a sensible order. It loads on the factor called Ordering which is described as: "The ability to arrange objects or events into a meaningful sequence."[10]

9. Sign Changes.- In this test, the subject must substitute one arithmetic operation sign for another before solving a given simple arithmetic problem. This test represents Symbol Substitution which is defined as: "The ability to substitute rapidly."[11]

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8 Guilford, Op. Cit., p. 22.

9 Ibid., p. 27.

10 Ibid., p. 25.

11 Ibid., p. 25.

10. Word-Group Naming.- This test requires the examinee to give a class name to a group of five words. It represents the factor called Concept Naming which is described as: "The ability to name relations and similarities."[12] Guilford[13] indicates that this factor, when contrasted with the factor called Object Naming, may represent the concrete-abstract dichotomy since one has to do with the naming of particulars while the other has to do with the naming of classes.

These tests were constructed by several authors. The method of construction of the tests used by Guilford is mentioned elsewhere by Kettner.[14] In each case, permission to reproduce the test was received from the originator, as indicated in Appendix 3, and they were then reproduced by mimeograph on 8½" by 11½" sheets of paper. In one case, i.e., Punched Holes, reproduction by mimeograph was not possible. Hence, the test was professionally reproduced in identical form as the original copy. The Numerical Operations, Part III was purchased directly from the publisher who also supplied the scoring stencils.

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12 Guilford, Op. Cit., p. 22.

13 Ibid., p. 7.

14 N.W. Kettner, An Information Summary of Studies of Thinking Abilities, Los Angeles, University of Southern California, 1955, ii-93 p.

2. Administration of the Tests.

The subjects were tested in groups ranging from four to ten individuals at one time. All of the tests were administered in group form with the exception of the Form Naming test. In order to avoid sequential effects of testing, the tests were randomized before each group administration. The total testing time was about one hour and a half per group with periodical breaks during this period. Before each test, the examiner read the instructions aloud as the group read them silently to themselves. After the instructions were read, the group was asked if they clearly understood what was to be done. If so, then the testing began.

At the end of the group testing, each subject was individually administered the Form Naming test and the Information subtest of the Wechsler Adult Intelligence Scale. This subtest was administered to both groups in order to obtain an estimate of their intelligence level. It was selected because its correlation with the full scale I.Q. is the highest of the total battery. That correlation is reported to be .87 between the ages of twenty-five and fifty-five.[15] The score an individual received on the Information

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15 David Wechsler, Manual for the Wechsler Adult Intelligence Scale, New York, The Psychological Corporation, 1955, p. 16-17.

test was converted to a scaled score and then multiplied by eleven. This value was then transformed to a full-scale I.Q. from the tables which corresponded to the subject's age group.

In addition to the above, the control group was asked to draw a picture of a person. The reason for this task will be explained in the following section.

3. Description of the Experimental and Control Groups.

The experimental population was composed of thirty male patients who were diagnosed as schizophrenic reaction. The diagnosis was considered final if it was made by at least two independent psychiatrists. The division of the number of patients according to the diagnostic sub-categories of schizophrenia is as follows: twenty paranoid schizophrenics, four simple schizophrenics, three acute undifferentiated schizophrenics, two catatonic schizophrenics, and one chronic undifferentiated schizophrenic.

The subjects were selected from the Psychiatric Unit of the District of Columbia General Hospital in Washington, D.C. Only those subjects who could read and write were included into the experimental group. All of the patients were newly admitted to the hospital and were tested approximately two to ten days after admission. Only three subjects

were not on medication at the time of testing. The remaining were being administered tranquilizers of varying dosages.

Other characteristics of the experimental and control groups are shown in Table II. Indicated in that table are the means, standard deviations and critical ratios of three variables: age, education, and estimated I.Q. level. A discussion of the comparison of the groups on these variables will follow subsequently.

The control group was composed of thirty individuals who are employed as correctional officers at the Youth Center; an institution of the District of Columbia Department of Corrections.

A brief screening device seemed necessary in the selection of the control group in order to determine whether any psychotic disorder was present despite the fact that these individuals were gainfully employed. There were asked to produce a drawing of a single person. These human figure drawings were then taken to three different psychologists who were asked to judge whether they were productions of a psychotic or non-psychotic subject. Only those cases which were agreed upon by all three psychologists as being non-psychotic were included into the control group. This group was also asked to fill out a brief historical questionnaire which included the following question: "Have you ever been hospitalized in a mental institution?" Those individuals

Table II.-

Critical Ratios of Means Between Normal and Schizophrenic Subjects on Age, Education, and Estimated I.Q.(N - 30).

Variable	Stat.	Group		Diff.	σ_D	C.R.	Signif.
		Schiz.	Control				
Age	M	32.46	33.03	.57	1.62	.35	-[a]
	σ	8.10	3.20	4.90	1.13	4.34	.01
	σ_M	2.26	.35				
	σ_σ	1.09	.17				
Education in Grades	M	12.27	11.93	.34	.75	.45	-
	σ	3.31	2.34	.97	.52	1.86	-
	σ_M	.38	.19				
	σ_σ	.18	.09				
Estimated I.Q. Level	M	102.56	108.83	6.27	4.68	1.34	-
	σ	18.70	16.93	1.77	3.25	.55	-
	σ_M	12.04	9.87				
	σ_σ	5.82	4.77				

a Significance levels greater than .01 are not reported.

who answered the question affirmatively were dropped from the control group.

The experimental and control groups were matched for age, education, estimated I.Q. level, and sex since it was felt that these variables may affect the performance on the experimental tests. The groups were compared through the use of the critical ratio test of uncorrelated groups and the results of this comparison are shown in Table II.

There was no significant difference found beyond the .01 level of probability between the means of the groups with respect to age, education, and estimated I.Q. level. Only one significant difference emerged from this comparison. That difference occurred in the standard deviations for the age variable. This seems to be due to the fact that the control group is more homogeneous than the experimental group with respect to age. The remaining tests of the standard deviations were found to yield non-significant differences.

4. Statistical Design.

The statistical analysis for the first hypothesis utilizes a D-method of factoring which has been reported by Osgood, Suci and Tannenbaum.[16] This is a method of factoring

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16 Charles E. Osgood, George J. Suci, and Percy H. Tannenbaum, The Measurement of Meaning, Urbana, University of Illinois Press, 1957, 1-342 p.

which is considered equivalent to the centroid method of factoring. The principal difference between the two techniques is that the centroid method begins with correlation coefficients in the original matrix while the D-Method of factoring can begin with either correlation coefficients or raw scores in the original matrix. The results of these two methods yield very similar factors. Evidence of the similarity of these two techniques is presented by the above authors in their book.[17]

The logic of this method of factoring is basic to correlational analysis. That is to say, the greater the relationship between any two columns of scores, the greater will be their sums of cross-products. Hence, if the two columns co-vary perfectly, then they can be considered as equivalent. This method uses the sums of cross-products to determine the relationship between any number of variables and yields results quite comparable to the traditional factor-analytic methods.

In order to distinguish the two methods of analysis, a different terminology is suggested. In the D-method of factoring, a "coordinate" can be considered the same as a "factor loading" and, a "dimension" can be considered equivalent to a "factor".

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17 Osgood, et al., Op. Cit., p. 42-46.

The method of analysis as applied to this investigation, proceeded from a matrix of raw scores. Since these scores were obtained from ten different tests with differing scoring systems, a procedure for normalizing the data was employed in order to make a given score comparable to any other score of a different test. Hence, the raw scores of both groups were converted into staninos. These stanine scores were then re-entered into a new matrix which formed the basis for the D-method of factoring.

The first dimension was extracted from the matrix by applying the following formula:

$$C_{I_i} = \frac{\Sigma X_{jh} X_{ji}}{\sqrt{\Sigma X_{jh}^2}}$$

where X_{jh} is the score of the "j"th individual on the "h"th test. All summations are over "j", where j = 1,2,3...k.

Similarly, the second dimension was obtained by applying the formula:

$$C_{II_i} = \frac{\Sigma X_{jg} X_{ji} - C_{I_g} C_{I_i}}{\sqrt{\Sigma X_{jg}^2 - C_{I_g}^2}}$$

where C_{I_g} is the coordinate of test "g" on dimension "I".

The third dimension was found by extending the above formula and is given as follows:

$$C_{III_i} = \frac{\Sigma X_{jf}X_{ji} - C_{I_f}C_{I_i} - C_{II_f}C_{II_i}}{\sqrt{\Sigma X_{jf}^2 - C_{I_f}^2 - C_{II_f}^2}}$$

This process continues until the dimension coordinates are reduced to zero or a negligible amount of variance of each test is left in the matrix. In this investigation, the process of extracting dimensions ceased when greater than ninety-five per cent of the variance of each test was accounted for by the total number of dimensions extracted. The percentage of the variance which each test contributed to each dimension was determined by the following formula:

$$V_{I_g} = \frac{C_{I_g}^2}{\Sigma X_{jg}^2}$$

where "V_{I_g}" is the percentage of the variance of test "g" that is associated with dimension "I"; and "C_{I_g}" is the coordinate of test "g" on dimension "I".

When the ninety-five per cent criterion was met, it was necessary to determine whether the dimension identified as the convergent-thinking dimension was the same for the normal and schizophrenic groups. In part, this was determined

through the use of the Pearson product-moment coefficient of correlation. The correlation was computed between the dimension coordinates and the percentage of the variance of each test for the convergent-thinking dimension. The formula used was:

$$r_{xy} = \frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{\left[N\Sigma X^2 - (\Sigma X)^2\right]\left[N\Sigma Y^2 - (\Sigma Y)^2\right]}}$$

This statistic, however, would only be able to indicate whether the dimensions increased or decreased in magnitude to a similar degree. The correlation ratio would not be able to indicate whether the differences between the variances of corresponding coordinates were large enough to be considered significantly different. In order to determine whether these differences were significant, a critical ratio of proportions was applied to only those tests which defined the convergent-thinking dimension. The formula used is as follows:

$$C.R. = \frac{p_1 - p_2}{\sigma_D}$$

where $$\sigma_D = \sqrt{\sigma_{p_1}^2 + \sigma_{p_2}^2}$$

and $$\sigma_{p_1}^2 = \frac{p_1 \; q_1}{N}$$

The second part of the statistical analysis is designed to test the hypothesis of the significance of the difference between the means of the groups on each of the convergent-thinking tests. The statistical test of significance used in each case was the critical ratio test for uncorrelated groups. The formula is given as:

$$C.R. = \frac{D}{\sigma_D}$$

where $\sigma_D = \sqrt{\sigma_{M_1}^2 + \sigma_{M_1}^2}$

and $\sigma_{M_1} = \frac{\sigma_1}{\sqrt{N-1}}$

A more precise measure of the differences between the means would be a critical ratio test for matched groups since the experimental and control groups were matched for age, education, and estimated I.Q. level. In this case, the standard error of the difference would be:

$$\sigma_D = \sqrt{\left[\sigma_{M_1}^2 + \sigma_{M_2}^2\right]\left[1-r^2\right]}$$

where r is a multiple correlation between the matched variables and the criterion variable. The advantage in the use of this formula is that the standard error of the difference is reduced by the magnitude of the correlation and,

therefore, maximizes the critical ratio value. In this investigation however, the critical ratio test for uncorrelated groups was applied first to determine if the differences between the means would be significant despite the fact that the correlation was not accounted for in the formula for the standard error of the difference. If the differences between the means were found to be significant, then it seemed unnecessary to employ the critical ratio test for matched groups since this formula would tend to increase the critical ratio beyond an already significant value and would not add any additional meaning to what had been found using the critical ratio test for uncorrelated groups.

In this chapter, the experimental design of the investigation was presented. It described the instruments to be used, the method of administration, the experimental and control populations, and the statistical analysis of the data. In the following, the results of this investigation will be presented and discussed.

CHAPTER III

RESULTS AND DISCUSSION

This chapter is divided into three parts. The first part will present the results of the D-Method of factoring. These findings will be discussed in terms of the first hypothesis. The second part deals with the difference in performance between the schizophrenic and control groups on the experimental tests. This part will be discussed with reference to the second hypothesis. The third part will present suggestions for further research.

1. Results of the D-Method of Factoring.

The results of the D-Method of factoring for the control and experimental groups are shown in Tables III and IV respectively. Indicated in those tables are the original coordinates of each test on each dimension. Since the coordinate values vary with the magnitude of the sums of the scores squared, a comparison between the two groups must necessitate some method for making the coordinates comparable. This was done by computing the percentage of the variance that each test contributes to each dimension according to the method described in Chapter II. The results now expressed in terms of the percentage of the total variance, are shown in

Table III.-

Coordinates of Each Test on Each Dimension for the Control Group.

Test	Dimensions					
	D_1	D_2	D_3	D_4	D_5	D_6
Inventive Opposites	29.33	.00	- .21	- .03	.15	.00
Word-Group Naming	28.67	2.27	1.96	1.43	1.58	.60
Correlate Completion II	27.89	2.80	- .97	3.09	5.40	.79
Camouflaged Words	27.72	1.88	4.17	3.34	.99	7.65
Sentence Order	27.58	4.48	1.74	5.70	2.24	3.08
Sign Changes	27.53	4.99	1.69	.00	6.20	.00
Numerical Operations	27.17	4.90	1.79	2.39	9.44	.00
Object Synthesis	26.73	5.64	10.67	.00	.00	.00
Punched Holes	26.76	6.61	1.92	9.83	.00	.00
Form-Naming	26.49	12.58	.00	- .41	.12	.33

Table IV.-

Coordinates of Each Test on Each Dimension for the Schizophrenic Group.

Test	Dimensions						
	D_1	D_2	D_3	D_4	D_5	D_6	D_7
Inventive Opposites	21.70	.00	.00	- .01	.01	.00	- .01
Word-Group Naming	19.82	-2.05	-2.06	-2.11	2.10	- .51	- .64
Correlate Completion II	17.93	2.22	1.51	.73	2.47	4.65	- .01
Camouflaged Words	15.99	2.08	.59	.68	6.18	.00	- .63
Sentence Order	16.18	-2.66	.99	4.89	2.41	-1.55	-1.67
Sign Changes	20.60	- .95	-1.03	-2.77	1.96	2.04	- .31
Numerical Operations	10.83	.43	.47	1.13	2.90	3.05	3.32
Object Synthesis	17.56	-2.53	-2.22	7.03	.78	- .42	- .30
Punched Holes	19.54	7.95	.00	.00	.00	.00	- .01
Form-Naming	13.27	1.60	7.64	.00	-.01	.01	.00

Tables V and VI for the control and experimental groups respectively.

The most prominent finding that appears in those tables is the emergence of a general convergent-thinking dimension indicated as Dimension I. All of the tests load heavily on this dimension suggesting that in both normals and schizophrenics, these tests are measuring similar cognitive processes. Furthermore, each test is contributing a larger amount of variance to the general convergent-thinking dimension than to the specific variance unique to the individual test characteristics.

The concern of this investigation is to determine whether the tests of convergent-thinking are measuring the same function in schizophrenics as they are in normals. Two very similar dimensions emerged from two independent analyses The question now remains: Can these dimensions be considered equivalent? One attempt to determine their equivalency was to correlate the coordinates of Dimension I of the control group with the coordinates of Dimension I of the schizophrenic group. A Pearson product-moment coefficient of correlation was found to be .98 between the raw coordinates, and .99 between the percentages of the variance of corresponding coordinates in both groups. Both of these correlations are significant beyond the .01 level of confidence. This suggests that the coordinate values co-vary to a degree that

Table V.-

Percentage of the Variance of Each Test on Each Dimension for the Control Group.

Test	Dimensions					
	D_1	D_2	D_3	D_4	D_5	D_6
Inventive Opposites	1.00	.00	.00	.00	.00	.00
Word-Group Naming	.96	.01	.00	.00	.00	.00
Correlate Completion II	.90	.01	.00	.01	.03	.00
Camouflaged Words	.89	.00	.02	.01	.00	.07
Sentence Order	.88	.02	.00	.04	.01	.01
Sign Changes	.88	.03	.00	.00	.05	.00
Numerical Operations	.86	.03	.00	.01	.10	.00
Object Synthesis	.83	.04	.13	.00	.00	.00
Punched Holes	.83	.05	.00	.11	.00	.00
Form-Naming	.82	.18	.00	.00	.00	.00

Table VI.-

Percentage of the Variance of Each Test on Each Dimension for the Schizophrenic Group.

Test	Dimensions						
	D_1	D_2	D_3	D_4	D_5	D_6	D_7
Inventive Opposites	1.00	.00	.00	.00	.00	.00	.00
Word-Group Naming	.97	-.01	-.01	-.01	.01	.00	.00
Correlate Completion II	.90	.01	.01	.00	.02	.06	.00
Camouflaged Words	.86	.01	.00	.00	.13	.00	.00
Sentence Order	.89	-.02	.00	.08	.02	-.01	.01
Sign Changes	.96	.00	.00	-.02	.01	.01	.00
Numerical Operations	.80	.00	.00	.01	.06	.06	.07
Object Synthesis	.84	-.01	-.01	.13	.00	.00	.00
Punched Holes	.86	.14	.00	.00	.00	.00	.00
Form-Naming	.74	.00	.25	.00	.00	.00	.00

could not be accounted for on the basis of chance alone. However, the fact that they co-vary consistently does not in itself indicate that the corresponding coordinates are equivalent since the difference between the coordinates may be quite large and still yield a significant correlation. Hence, a critical ratio of the proportions was performed on the corresponding coordinates of Dimension I between the schizophrenic and control groups. The results of this test are shown in Table VII. An inspection of this table reveals that the differences between the percentage of the variance that each test contributes to the general convergent-thinking dimension are not significant between the schizophrenic and control groups. This suggests, therefore, that the experimental tests are measuring the same function in schizophrenics as they are in normals, and that the convergent-thinking activity is operative in schizophrenics as well as in normals. This leads to the conclusion that convergent-thinking activity of schizophrenic patients does not differ essentially, or in kind, from the convergent-thinking activity of normal subjects. The first hypothesis cannot be rejected by this investigation. That hypothesis is as follows: There is no significant difference between the dimension accounting for the variance of the convergent-thinking activity of schizophrenic and normal subjects.

Table VII.-

Critical Ratios of Percentages of the Variance of Dimension I of the Control and Schizophrenic Groups for Each of the Ten Tests (N = 30).

Test	Stat.	Group		Diff.	σ_D	C. R.
		Control	Schiz.			
Inventive Opposites	p	1.00	1.00	.00	.000	--
	σ_p^2	.000	.000			
Word-Group Naming	p	.98	.97	.01	.045	.222
	σ_p^2	.001	.001			
Correlate Completion II	p	.90	.90	.00	.078	--
	σ_p^2	.003	.003			
Camouflaged Words	p	.89	.86	.03	.084	.357
	σ_p^2	.003	.004			
Sentence Order	p	.88	.89	.01	.084	.119
	σ_p^2	.004	.003			
Sign Changes	p	.88	.96	.08	.071	1.127
	σ_p^2	.004	.001			
Numerical Operations	p	.86	.80	.06	.095	.632
	σ_p^2	.004	.005			
Object Synthesis	p	.83	.84	.01	.095	.105
	σ_p^2	.005	.004			
Punched Holes	p	.83	.86	.03	.095	.316
	σ_p^2	.005	.004			
Form-Naming	p	.82	.74	.08	.105	.762
	σ_p^2	.005	.006			

Before leaving the analysis of the D-method of factoring, some other results are worth noting. It can be observed that the schizophrenic patients acquired one more dimension than the normal group. It appears that the dimensions of the schizophrenic group increase in their specificity due, perhaps, to some extraneous variables that are added to the cognitive processes by the schizophrenic patient. An analysis of these specific variables that show a decrease in their loadings on the convergent-thinking dimension and an increase in their loadings on the specific test dimension, may yield significant information regarding the unique qualities of schizophrenic functioning. An item analysis of the specific scales would be of value in determining the manner of response that is most characteristic of schizophrenic patients.

The results of this investigation do not agree with the conclusions made by either Simkin[1] or Cohen.[2] Their contention was that there are basic differences in cognitive functioning between schizophrenics and normals because the factor loadings of the schizophrenic group on the "G" factor

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1 J.S. Simkin, "An Investigation of Differences in Intellectual Factors between Normal and Schizophrenic Adults", in Microfilm Abstracts, Vol. 11, No. 2, 1951, p. 448-449.

2 J. Cohen, "Factors Underlying Wechsler-Bellevue Performance of Three Neuropsychiatric Groups", in Journal of Abnormal and Social Psychology, Vol. 47, No. 2, 1952, p. 359-365.

were lower than in the normal group. In this investigation it has been noted that the coordinate values on the convergent-thinking dimension were not significantly different between the two groups. This suggests that perhaps the reason for the shifting of the factor loadings in the above-mentioned studies may be due to the multidimensional aspects of the variables involved. If the tests are a composite of a number of variables, then a change in any one of these variables may produce a significant shift in the factor loadings of a given test. The fact that it has been shown by Cohen[3] that the subtests of the Wechsler-Bellevue Intelligence Scale do load on a number of factors at the same time, supports the argument that shifts in factor loadings may be due to extraneous variables rather than the one that is assumed to be operative.

Another point of interest in this investigation is whether Guilford's classification of factors according to Table I emerges in this analysis.

Dimension II appears to be a figural dimension since it incorporates those tests in which perceived form is essential. Dimension III has only two tests which load on it substantially. These tests require that the subject perceive objects in a new or different way. This dimension, therefore,

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3 Cohen, Op. Cit., p. 359-365.

seems to correspond to the row in Table I called "transformations". Dimension IV is ambiguous. It includes the tests called Punched Holes and Sentence Order which are in different rows and different columns. It suggests that since the test Punched Holes did not appear in the row named "transformations", that perhaps it is more meaningfully related to figural ordering than to its present location. Dimension V appears to be a dimension of "unique conclusions" and Dimension VI is specific to the test Camouflaged Words which represents a factor called Structural Redefinition.

Some of the logical categories, therefore appear valid while others do not appear at all. There is no overall structural or naming dimension while the conceptual and correlate dimensions appear to be subsumed under Dimension I. The schizophrenics have more specific dimensions than the normals. Dimensions II, III, and VII are specific dimensions accounting for most of the residual variance of a single test. Dimension IV seems to be a conceptual dimension since it is identified by two tests in which verbal concepts are common to both. Dimensions V and VI are both structural dimensions which have separated for some inexplicable reason.

2. Performance of the Samples on the Experimental Tests.

The second hypothesis states that there is no significant difference between the performance of the schizophrenic and normal subjects on any of the convergent-thinking tests. To test this hypothesis, a critical ratio of means was performed on the raw data and the results are shown in Table VIII.

The results of the critical ratio test indicate that the schizophrenics performed significantly lower than normal on all of the convergent-thinking tests. The differences between the means of both groups were found to be significant beyond the .01 level of confidence. The second hypothesis, therefore, is rejected by this investigation.

These results are in agreement with those found by Wilkins[4] on the Primary Mental Abilities Test. The results of that study indicated that schizophrenic patients performed significantly lower than normals on every factor. The concurrence between the results of the present investigation and the one mentioned above suggests the hypothesis that schizophrenic cognitive functioning reflects a generalized rather than a differential deficit.

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4 Muriel Wilkins, Is there a Schizophrenic Pattern on the P.M.A.?, unpublished Masters Thesis presented to the School of Psychology and Education of the University of Ottawa, Ontario, 1959, vii-75 p.

Table VIII.-

Critical Ratio of Mean for Each Test Between the Schizophrenic and Control Groups (N = 30).

Test	Stat.	Schiz.	Control	Diff.	σ_D	C.R.	Signif.
Inventive Opposites	M	14.00	22.80	8.80	2.86	3.08	.01
	σ	11.60	10.13				
	σ_M	4.63	3.53				
Sign Changes	M	8.63	14.83	6.20	1.67	3.71	.001
	σ	6.70	5.97				
	σ_M	1.55	1.23				
Object Synthesis	M	4.53	8.03	3.50	.81	4.32	.001
	σ	3.43	2.70				
	σ_M	.41	.25				
Word Group Naming	M	7.20	13.37	6.17	1.50	4.11	.001
	σ	6.23	5.17				
	σ_M	1.34	.92				
Camouflaged Words	M	2.10	6.67	4.57	.99	4.62	.001
	σ	3.27	4.20				
	σ_M	.37	.61				
Numerical Operations	M	27.97	73.03	45.06	6.28	7.18	.001
	σ	18.20	28.53				
	σ_M	11.41	28.02				
Punched Holes	M	2.10	4.87	2.77	.82	3.38	.01
	σ	3.27	3.33				
	σ_M	.37	.38				
Correlate Completion II	M	5.50	13.97	8.47	2.63	3.22	.01
	σ	9.27	10.73				
	σ_M	2.96	3.96				
Sentence Order	M	4.07	8.60	4.53	.86	5.27	.001
	σ	3.70	2.77				
	σ_M	.47	.26				
Form Naming	M	118.77	72.17	46.60	5.09	9.16	.001
	σ	25.00	11.40				
	σ_M	21.51	4.47				

3. Suggestions for Further Research.

These findings indicate that convergent-thinking activity in schizophrenic patients is reduced markedly. That is to say, that when confronted with a task in which one conclusion or unique answer is required, schizophrenics show an inability to function effectively. This seems to be the case despite the type of results or the type of stimulus that is presented. What seems suggested, therefore, is that when pathology ensues, a generalized inability to function effectively on a cognitive level seems to predominate.

Halstead[5] describes a similar process in organic patients which seems applicable in this case. He describes a "P" factor which seems to reflect:

> (...) the undistorted power factor of the brain. It operates to counterbalance or regulate the affective forces and thus frees the growth principle of the ego for further ego differentiation.[6]

The power factor seems to be not only a counterbalance to disruptive affective states, but also an energizer of cortical functioning. Halstead states:

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5 Ward C. Halstead, Brain and Intelligence, A Quantitative Study of the Frontal Lobes, Chicago, University of Chicago Press, 1947, v-206 p.

6 Ibid., p. 147.

> The P factor is a dynamic factor which, in terms of a single estimation, probably best reflects the over-all status of the brain. It is sensitive to the presence of the relatively small lesions in the brain and to the effects of low-grade anoxia. There is reason to believe that it is also sensitive to certain concommitants of fatigue states. Its specific physiology is unknown, but it would not be surprising should it be found to parallel those vital processes which sustain the brain and cortex at a high level of efficiency.[7]

It is unfortunate that the power factor has not been investigated in the functional psychoses, since the severe reduction of cognitive functioning as observed in this investigation suggests that such a factor may be operative in schizophrenia. If such is the case, then it should not be surprising that an inhibitory process is operative in schizophrenics since their total functioning is tempered by affective processes which, as Halstead suggests, is inversely related to the efficiency of the "P" factor.

This kind of framework would seem to also account for the response patterns which appear characteristic of schizophrenics. It is quite probable that the phenomenon of over-inclusive thinking or a concrete attitude reflects the manner of schizophrenic response when the power factor or the energy level of the cortex is reduced to the extent that an appropriate response cannot be given.

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7 Halstead, Op. Cit., p. 98.

Further research is suggested to determine whether this process of energy reduction or inhibition is reversable in the functional psychoses. This investigation suggests that convergent-thinking is the same in schizophrenics as it is in normals, but that they differ significantly on the level or degree of functioning. It may be hypothesized, for example, that when a schizophrenic patient recovers from his psychotic adjustment, his ability to operate effectively on a cognitive level is also restored. One way in which this could be studied would be to investigate cases of pre- and post-psychoses. Another possibility would be through the use of the psychotomimetic drugs; the assumption being that as the affective states predominate, the power factor or energy level is reduced thus rendering cognitive processes ineffective. If such functions as convergent-thinking appear restored upon recovery, then we may have further evidence that schizophrenic thinking differs from normal thinking in degree more than in kind.

Another area of research that could be suggested is the continued investigation of Guilford's model of the structure of the intellect. It may be hypothesized that if schizophrenics show a generalized reduction of convergent-thinking functions, then differences between schizophrenics and normals may emerge on divergent-thinking activity and other functions.

Angyal,[8] for example, suggests that the schizophrenic patient is not impaired insofar as apprehending relationships are concerned, but in the apprehension of systems. This seems related to the factors called "cognition" within Guilford's system. These factors have to do with the apprehension, recognition or discovery of constructs of one kind or another. If Angyal's hypothesis is correct, then there should be no difference between schizophrenics and normals on these factors.

Bleuler[9] suggests that memory functions are not disturbed in schizophrenics. This hypothesis, too, seems testable in terms of Guilford's memory factors.

It is important to mention at this point that continued research with other nosological groups is necessary. It would be significant to determine how neurotics and other psychotic groups perform on these tests of convergent-thinking and whether they may be differentiated from each other along a continuum of convergent-thinking activity.

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8 A. Angyal, "Disturbances of Thinking in Schizophrenia", in J.S. Kasanin, Language and Thought in Schizophrenia, Berkley, University of California Press, 1944, p. 115-123.

9 Eugen Bleuler, "The Basic Symptoms of Schizophrenia", in David Rapaport, Organization and Pathology of Thought, New York, Columbia University Press, p. 399-450.

The possibility exists that perhaps these tests of convergent-thinking may be used as indices of the extent of pathology. It seems improbable that the decrease in efficiency of cognitive functioning occurs abruptly and suddenly in the development of schizophrenia. It is more likely that the process develops through progressive stages. If this is so, then cognitive functioning should also manifest a decrease in efficiency in progressive stages. This suggests the possibility of relating convergent-thinking deficits with increasing stages of pathology or chronicity. The hypothesis is advanced, then, that as the severity of the psychotic disorder increases, the effective use of convergent-thinking function decreases. Further, if this process can be assumed to be reversible, then we should be able to expect an increase in the efficient use of convergent-thinking functions as one progresses toward a normal adjustment. Implied in the above is the suggestion that a measure of cognitive functioning may serve as an indicator in detecting the positive effects of psychotherapy.

In the above, a number of hypotheses have been advanced for further research. It is admitted that these hypotheses are only logical hypotheses which may or may not be true. However, they have been suggested in order that they may guide further investigations in this area.

In the following section, a summary of the entire investigation will be presented.

SUMMARY AND CONCLUSIONS

The basic hypotheses arose from the question of whether schizophrenic cognitive functioning differed essentially from normal cognitive functioning. In terms of the scope of this investigation, it was hypothesized that there is no significant difference between the dimension accounting for the variance of convergent-thinking activity between schizophrenic and normal subjects. Convergent-thinking activity refers to those cognitive tasks in which there is almost always one conclusion or answer that is unique to the problem. The analysis of the data did not permit a rejection of the first hypothesis. This implied that, with respect to convergent-thinking activity, schizophrenic patients and normal subjects demonstrate a similar cognitive process.

The second hypothesis is concerned with determining if there were any significant differences between the performance of the two groups on any of the convergent-thinking tests. The analysis of the differences between the means leads to the rejection of the hypothesis that there were no significant differences between the two groups. These results implied that the difference between schizophrenic and normal subjects on convergent-thinking activity lies in the effective use of this ability.

These conclusions were interpreted within the framework of Halstead's "P" factor suggesting that a reduction of cortical energy may exist in schizophrenic patients which could account for the inhibition of the effective use of cognitive functions. Further hypotheses for subsequent research are advanced in the body of the thesis.

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This article is an amplification of the earlier study reported in 1956. It reports Guilford's latest findings with respect to the factors of intellect. It also points out areas of future research and reviews some of the more important implications of the conclusions presented. This report is a worthwhile publication.

Halstead, Ward C., Brain and Intelligence, A Quantitative Study of the Frontal Lobes, Chicago, University of Chicago Press, 1947, v-206 p.

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Kettner, Norman W., An Information Summary of Studies of Thinking Abilities, Los Angeles, University of Southern California, 1955, ii-93 p.

An exhaustive and detailed report of the results of all the factor-analytic studies performed by the Psychological Laboratory of the University of Southern California.

Osgood, Charles E., George J. Suci, and Percy H. Tannenbaum, The Measurement of Meaning, Urbana, University of Illinois Press, 1957, 1-342 p.

This book presents a detailed account of the derivation and use of the D-Method of Factoring. An example of the application of the technique is given in the Appendix of the book.

Payne, R.W., "Cognitive Abnormalities", in H.J. Eysenck, Handbook of Abnormal Psychology, An Experimental Approach, New York, Basic Books, 1961, p. 193-261.

An excellent review of the literature on schizophrenic cognitive functioning.

APPENDIX 1

CAMOUFLAGED WORDS -CAX04A

NAME (Print) _____ TESTING NUMBER _____
Last First Middle

GROUP _____ DATE _____

In this test you will be given a series of sentences. Concealed in each sentence is the name of a sport or game. The letters of the name of the sport or game appear in their correct order, without intervening letters. They may appear within a longer word, or they may appear as the end of one word and the beginning of another. You are to find the name of the sport or game and make a circle around the letters forming it.

Look at this example:

COWARDICE IS NOT A SOLDIERLY ATTRIBUTE.

In this case the name of the game is DICE, which appears as part of the longer word COWARDICE, and has been correctly marked.

Now try this example:

TO HELP BEAT THE HUN, TIN GOES A LONG WAY.

In this case the name of the sport is HUNTING, made up of the word HUN, the word TIN, and the first letter of GOES. Draw a circle around these letters in the sentence.

Remember, it is the sequency of the letters that makes up the name of the sport or game; punctuation marks are to be ignored.

This test consists of two parts, each containing 10 items. You will have 4 minutes for each part.

Are there any questions?

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

APPENDIX 1

PART I

1. One could tell he was a Mongol from his costume.

2. "I'm keeping the job I've got, racket or not," said the gangster.

3. She was as graceful as a nymph, and bellet dancing came to her naturally.

4. The Kentucky Colonel found some bad mint on the top of his mint julep.

5. He's not much good, but pitches shut-out games occasionally.

6. We traced the shipment, and found the missing box in Gulfport, La.

7. For a Christmas present, he handed me an "El Ropo," lousiest cigar on the market.

8. I am sorry; I didn't know he was ailing.

9. We used to be good friends, but I haven't seen Lucas in over a year now.

10. In most American colleges a well-rounded education is the standard; arts and sciences dominate the curriculum.

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

APPENDIX 1

PART II

11. She got her husband to beat the rug by telling him how good the exercise would be for him.

12. In computing effective lift (hydrogen per square foot), ballonists must consider atmospheric pressure.

13. The white flour in one bin got mixed with the wholewheat flour in another bin.

14. Whenever Maisie gets her diamond ring out of hock, eyes turn to her as if she were wearing a headlight.

15. Willie's mother took one look at the pup he brought home, and said, "Take that hybrid, germ-laden beast out of here."

16. The immigration authorities admitted some extra Cingalese natives to this country last month.

17. The Empire State Building is so tall the roof is hinged to swing out of the way to let the moon go by.

18. Over her eyes, the brim of her hat formed an arc; her years were concealed in its shadow.

19. Although the river was deep, we managed to pull across easily.

20. "Are you hep?" "Oo, <u>love</u> that boogie beat! "

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

APPENDIX 1

CORRELATE COMPLETION II — RECOLA

NAME (Print) _____ TESTING NUMBER _____
Last First Middle

GROUP _____ DATE _____

In this test your task will be to find relationships between words. Each item in this test consists of two pairs of words and a single word. You are to supply a word which bears the same relation to the single word as the relation between the words in the first two pairs.

Look at the following examples:

a. am ma not ton tool ? ..... loot

b. enrage rage correlate late about ? ..... bout

In these examples the correct word is given in the blank to the right of the dotted lines. In the first example the letters are in reverse order in each pair and in the second example the second word of each pair consists of the last four letters of the first word.

In each of the remaining items find the word that completes the third pair and write your answer in the blank at the extreme right of that line.

The test consists of two parts each containing 20 items. You will have 6 minutes working time for each part. Are there any questions?

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

APPENDIX 1
PART I

1. thumb hum want an maiden ? .....
2. examine in infamy am monitor ? .....
3. tomato to intent it berry ? .....
4. niece nee striver sir bemoaning ? .....
5. pots stop bard drab rats ? .....
6. sell tell louse mouse ear ? .....
7. gander rag fluctuate elf turnip ? .....
8. troop port good dog wall ? .....
9. went wont pant pint stint ? .....
10. steel sleet frail flair start ? .....
11. company come candle cane forget ? .....
12. relapse ear ten net embellishment ? .....
13. them then silk sill scald ? .....
14. traffic raft drink rind stowaway ? .....
15. stems met drop or emetic ? .....
16. handful haul flotsam foam rapid ? .....
17. pistol piston par pat sine ? .....
18. moat at contralto alto morally ? .....
19. add bee aha bib end ? .....
20. curry cry siestas sets ferment ? .....

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

21. domino do brace be memory ___?___ ....._____

22. travel rave model ode enamel ___?___ ....._____

23. forward draw esteem meet pastime ___?___ ....._____

24. bent cent last mast bow ___?___ ....._____

25. disclosure dire reprint rent machine ___?___ ....._____

26. boor rob steel lets drool ___?___ ....._____

27. sloop spool snail slain drear ___?___ ....._____

28. develop pod kettle elk telegram ___?___ ....._____

29. mean mien homed humid fleas ___?___ ....._____

30. bulb bull balm ball silo ___?___ ....._____

31. ratchet tear dabbled dead tackling ___?___ ....._____

32. mass mast card care stalk ___?___ ....._____

33. stack cat snip in relate ___?___ ....._____

34. romper prom ringing grin penology ___?___ ....._____

35. digest diet slant sat servant ___?___ ....._____

36. start art tether ether cheat ___?___ ....._____

37. garner garnet look loom pine ___?___ ....._____

38. nee off her ifs its ___?___ ....._____

39. blast bat turnout trot parking ___?___ ....._____

40. hormone on helmet me demeanor ___?___ ....._____

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

APPENDIX 1

INVENTIVE OPPOSITES - CAFO7A

NAME (print)_____ TESTING NUMBER_____

GROUP_____ DATE_____

This is a test of your ability to think of words under certain conditions. Think of two different words opposite in meaning to the word narrow below. One word should begin with b. The other should begin with w. The words are broad and wide. These words have been written in the blanks.

NARROW b *broad* w *wide*

Now think of two words opposite in meaning to the word large. The first should begin with l; the second with s.

LARGE l_____ s_____

The words are little and small. Write little in the first blank. Write small in the second.

Go ahead with the exercises on this page. For each word that is given write two other words of opposite meaning. The words must begin with the letters indicated. Go right ahead. Do not wait for any signal.

STRONG f_____ w_____

WRONG r_____ c_____

DARK b_____ l_____

When the signal is given (not yet) turn the page and complete more items of the same kind.

Your score will be the total number of correct answers, so do not spend too much time on a difficult item. Skip it and go to the next. You may not finish in the time allowed. The words must begin with the letters indicated.

There are two parts. You will have 3 minutes for each part.

Are there any questions?

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

PART I

1.	EASY	d_____	h_____
2.	POVERTY	w_____	r_____
3.	TRUTH	l_____	f_____
4.	CLEAN	d_____	s_____
5.	BEAUTIFUL	h_____	u_____
6.	FIERCE	t_____	m_____
7.	TALKATIVE	s_____	q_____
8.	COMBINE	s_____	d_____
9.	EXCESSIVE	m_____	t_____
10.	COARSE	d_____	f_____
11.	MODERATE	c_____	i_____
12.	GENUINE	i_____	u_____
13.	DISCORD	p_____	h_____
14.	CORRUPT	h_____	u_____
15.	SAFETY	h_____	d_____

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

APPENDIX 1

PART II

16.	SILENT	l_____	n_____
17.	GLOOMY	c_____	h_____
18.	CHEAP	e_____	c_____
19.	CLOSE	d_____	f_____
20.	RUDE	c_____	p_____
21.	FRIGID	t_____	h_____
22.	ELATED	s_____	d_____
23.	ERRONEOUS	a_____	c_____
24.	MODEST	c_____	b_____
25.	INCOMPETENT	a_____	s_____
26.	HYPOCRITICAL	s_____	h_____
27.	INDIFFERENT	e_____	i_____
28.	SPEND	h_____	s_____
29.	TENTATIVE	f_____	p_____
30.	BORING	a_____	e_____

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

THE GUILFORD-ZIMMERMAN APTITUDE SURVEY

Part III Numerical Operations

FORM A

Name_____ Date_____ Score_____

Nearest age (encircle): 10 15 20 25 30 35 45 55 65 75 Sex: M F

Years of school completed: 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Instructions.—This is a test of how rapidly and accurately you can do number operations—addition, subtraction, and multiplication.

Look at the sample problems below:

ADD

28		77
65		83
52		12
▬	145	=
=	154	=
=	155	=
=	172	=
=	174	=
=	182	=

SUBTRACT

94		74
−55		−38
=	27	=
=	29	=
=	36	=
▬	39	=
=	46	=
=	47	=

MULTIPLY

94		52
X 5		X 9
=	358	=
=	380	=
=	458	=
=	460	=
=	468	=
▬	470	=

The first pair of problems call for addition. The sum of the first problem is 145. Look for this answer in the list of six numbers below the two addition problems. The answer space to the left of 145 and on a level with it is blackened as it should be. The sum of the second problem is 172. The answer space at the right of 172 should be blackened. Do that now.

Examine the remaining practice problems in turn and mark the answers that need to be marked.

The right answers to the two unmarked problems are 36, and 468, in the subtraction, and multiplication groups, respectively.

When the signal is given, BUT NOT BEFORE, turn the page and begin working on the problems of the test. The problems will always be in pairs, as in the samples. Mark the answer to each problem in an answer space directly below it. Do each problem as it comes, working across each row of problems on the page. You need not write the numerical answer, but there is room for this if you care to do so. In any case, be sure to record your answer by making a heavy mark in the proper answer space for each problem. ONLY THESE MARKS WILL BE SCORED. If you should change an answer, be sure to erase your old mark.

KEEP ON WORKING RAPIDLY UNTIL TIME IS CALLED. You will have 8 minutes for the entire test. If you finish before time is called, you may go back to check your work. If you have any questions, ask them NOW.

DO NOT TURN THE PAGE UNTIL GIVEN THE SIGNAL TO BEGIN

ADD

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
31	67	58	98	23	17	35	53	66	60	64	37
68	28	22	74	51	84	99	16	27	53	25	88
89	40	30	77	82	56	48	83	35	34	94	60
= 135	=	= 110	=	= 147	=	= 151	=	= 128	=	= 173	=
= 148	=	= 117	=	= 149	=	= 152	=	= 129	=	= 175	=
= 188	=	= 120	=	= 156	=	= 181	=	= 137	=	= 182	=
= 196	=	= 239	=	= 157	=	= 182	=	= 138	=	= 183	=
= 198	=	= 247	=	= 166	=	= 191	=	= 147	=	= 185	=
= 206	=	= 249	=	= 169	=	= 192	=	= 149	=	= 192	=

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
39	44	70	14	21	11	95	45	27	12	59	92
63	81	19	86	87	46	20	76	33	61	72	43
95	32	97	54	38	55	58	38	96	78	34	21
= 156	=	= 144	=	= 106	=	= 159	=	= 141	=	= 154	=
= 157	=	= 154	=	= 107	=	= 160	=	= 146	=	= 155	=
= 158	=	= 155	=	= 112	=	= 163	=	= 150	=	= 156	=
= 196	=	= 156	=	= 142	=	= 169	=	= 151	=	= 165	=
= 197	=	= 185	=	= 146	=	= 170	=	= 156	=	= 174	=
= 198	=	= 186	=	= 147	=	= 173	=	= 160	=	= 176	=

(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)
57	91	49	65	67	91	45	24	29	18	69	62
42	15	93	26	68	54	90	73	52	71	50	24
76	41	13	85	31	47	36	89	80	47	75	86
= 138	=	= 145	=	= 151	=	= 171	=	= 115	=	= 172	=
= 145	=	= 155	=	= 156	=	= 186	=	= 125	=	= 173	=
= 147	=	= 164	=	= 166	=	= 187	=	= 126	=	= 182	=
= 148	=	= 174	=	= 182	=	= 191	=	= 136	=	= 184	=
= 167	=	= 176	=	= 191	=	= 196	=	= 151	=	= 193	=
= 175	=	= 186	=	= 192	=	= 197	=	= 161	=	= 194	=

Continue on page 3

SUBTRACT

(37)	(38)	(39)	(40)	(41)	(42)	(43)	(44)	(45)	(46)	(47)	(48)
51	82	78	55	65	97	67	71	83	41	54	64
−13	−35	−42	−17	−26	−57	−34	−52	−44	−16	−18	−13
= 28 =	= 38 =	= 36 =	= 38 =	= 28 =	= 29 =	= 19 =	= 20 =	= 24 =	= 25 =	= 30 =	= 31 =
= 38 =	= 47 =	= 37 =	= 46 =	= 29 =	= 30 =	= 20 =	= 23 =	= 25 =	= 34 =	= 31 =	= 36 =
= 47 =	= 49 =	= 38 =	= 47 =	= 30 =	= 38 =	= 23 =	= 29 =	= 34 =	= 35 =	= 36 =	= 41 =
= 49 =	= 57 =	= 46 =	= 47 =	= 38 =	= 39 =	= 29 =	= 30 =	= 35 =	= 39 =	= 41 =	= 50 =
= 57 =	= 59 =	= 47 =	= 48 =	= 39 =	= 40 =	= 30 =	= 33 =	= 39 =	= 49 =	= 50 =	= 51 =
= 59 =	= 69 =	= 48 =	= 49 =	= 40 =	= 41 =	= 33 =	= 34 =	= 49 =	= 50 =	= 51 =	= 52 =

(49)	(50)	(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	(60)
69	98	85	32	94	76	77	91	72	81	60	92
−25	−29	−57	−15	−68	−46	−30	−79	−20	−33	−23	−58
= 38 =	= 44 =	= 7 =	= 17 =	= 16 =	= 20 =	= 12 =	= 21 =	= 48 =	= 50 =	= 27 =	= 33 =
= 44 =	= 48 =	= 17 =	= 18 =	= 20 =	= 26 =	= 21 =	= 22 =	= 50 =	= 52 =	= 33 =	= 34 =
= 48 =	= 54 =	= 18 =	= 19 =	= 26 =	= 28 =	= 22 =	= 37 =	= 52 =	= 58 =	= 34 =	= 37 =
= 54 =	= 59 =	= 19 =	= 27 =	= 28 =	= 30 =	= 37 =	= 47 =	= 58 =	= 60 =	= 37 =	= 43 =
= 59 =	= 69 =	= 27 =	= 28 =	= 30 =	= 38 =	= 47 =	= 52 =	= 60 =	= 62 =	= 43 =	= 44 =
= 69 =	= 75 =	= 28 =	= 38 =	= 38 =	= 39 =	= 52 =	= 62 =	= 62 =	= 63 =	= 44 =	= 45 =

(61)	(62)	(63)	(64)	(65)	(66)	(67)	(68)	(69)	(70)	(71)	(72)
56	75	93	50	86	89	95	62	45	70	99	73
−25	−39	−66	−11	−48	−62	−58	−36	−27	−31	−59	−37
= 31 =	= 32 =	= 17 =	= 27 =	= 16 =	= 17 =	= 26 =	= 27 =	= 18 =	= 28 =	= 30 =	= 36 =
= 32 =	= 36 =	= 27 =	= 38 =	= 17 =	= 26 =	= 27 =	= 36 =	= 28 =	= 37 =	= 36 =	= 37 =
= 36 =	= 41 =	= 38 =	= 39 =	= 26 =	= 27 =	= 36 =	= 37 =	= 37 =	= 39 =	= 37 =	= 40 =
= 41 =	= 42 =	= 39 =	= 48 =	= 27 =	= 28 =	= 37 =	= 38 =	= 39 =	= 47 =	= 40 =	= 46 =
= 42 =	= 46 =	= 48 =	= 49 =	= 28 =	= 38 =	= 38 =	= 48 =	= 47 =	= 49 =	= 46 =	= 47 =
= 46 =	= 47 =	= 49 =	= 50 =	= 38 =	= 39 =	= 48 =	= 49 =	= 49 =	= 50 =	= 47 =	= 48 =

(73)	(74)	(75)	(76)	(77)	(78)	(79)	(80)	(81)	(82)	(83)	(84)
64	97	43	72	63	67	84	47	88	83	80	61
−40	−58	−29	−37	−28	−29	−69	−19	−21	−14	−24	−12
= 24 =	= 28 =	= 14 =	= 24 =	= 25 =	= 27 =	= 15 =	= 17 =	= 67 =	= 69 =	= 38 =	= 46 =
= 28 =	= 34 =	= 24 =	= 25 =	= 27 =	= 28 =	= 17 =	= 18 =	= 69 =	= 70 =	= 46 =	= 48 =
= 34 =	= 38 =	= 25 =	= 26 =	= 28 =	= 35 =	= 18 =	= 25 =	= 70 =	= 77 =	= 48 =	= 49 =
= 38 =	= 39 =	= 26 =	= 35 =	= 35 =	= 37 =	= 25 =	= 27 =	= 77 =	= 79 =	= 49 =	= 56 =
= 39 =	= 48 =	= 35 =	= 36 =	= 37 =	= 38 =	= 27 =	= 28 =	= 79 =	= 80 =	= 56 =	= 59 =
= 48 =	= 49 =	= 36 =	= 37 =	= 38 =	= 39 =	= 28 =	= 29 =	= 80 =	= 81 =	= 59 =	= 60 =

Continue on page 4

MULTIPLY

(85)	(86)	(87)	(88)	(89)	(90)	(91)	(92)	(93)	(94)	(95)	(96)
56	68	82	95	47	34	39	54	55	32	71	39
X 9	X 5	X 4	X 3	X 6	X 8	X 3	X 4	X 5	X 8	X 6	X 4
= 304	=	= 285	=	= 248	=	= 117	=	= 254	=	= 126	=
= 340	=	= 295	=	= 272	=	= 127	=	= 256	=	= 156	=
= 350	=	= 326	=	= 276	=	= 215	=	= 265	=	= 364	=
= 404	=	= 328	=	= 282	=	= 216	=	= 266	=	= 426	=
= 504	=	= 331	=	= 286	=	= 225	=	= 275	=	= 427	=
= 540	=	= 338	=	= 322	=	= 226	=	= 284	=	= 437	=

(97)	(98)	(99)	(100)	(101)	(102)	(103)	(104)	(105)	(106)	(107)	(108)
58	40	63	37	24	40	38	57	65	78	53	41
X 6	X 7	X 5	X 7	X 9	X 6	X 9	X 6	X 5	X 7	X 5	X 8
= 280	=	= 249	=	= 216	=	= 332	=	= 325	=	= 265	=
= 296	=	= 255	=	= 222	=	= 342	=	= 344	=	= 275	=
= 320	=	= 259	=	= 226	=	= 346	=	= 425	=	= 316	=
= 338	=	= 269	=	= 230	=	= 352	=	= 536	=	= 318	=
= 348	=	= 315	=	= 232	=	= 356	=	= 546	=	= 326	=
= 356	=	= 325	=	= 240	=	= 381	=	= 547	=	= 328	=

(109)	(110)	(111)	(112)	(113)	(114)	(115)	(116)	(117)	(118)	(119)	(120)
59	76	61	98	75	50	97	31	99	28	60	93
X 9	X 3	X 5	X 3	X 4	X 8	X 3	X 8	X 3	X 7	X 8	X 6
= 218	=	= 294	=	= 290	=	= 248	=	= 182	=	= 362	=
= 226	=	= 296	=	= 300	=	= 258	=	= 196	=	= 480	=
= 228	=	= 300	=	= 308	=	= 291	=	= 197	=	= 490	=
= 451	=	= 305	=	= 320	=	= 294	=	= 292	=	= 552	=
= 531	=	= 314	=	= 360	=	= 301	=	= 296	=	= 558	=
= 536	=	= 315	=	= 400	=	= 304	=	= 297	=	= 578	=

(121)	(122)	(123)	(124)	(125)	(126)	(127)	(128)	(129)	(130)	(131)	(132)
29	64	67	31	45	27	85	43	73	36	83	96
X 4	X 6	X 3	X 7	X 6	X 9	X 4	X 9	X 5	X 7	X 4	X 7
= 112	=	= 181	=	= 224	=	= 318	=	= 242	=	= 332	=
= 116	=	= 201	=	= 233	=	= 320	=	= 252	=	= 336	=
= 126	=	= 214	=	= 243	=	= 340	=	= 365	=	= 342	=
= 382	=	= 217	=	= 254	=	= 387	=	= 370	=	= 662	=
= 384	=	= 224	=	= 260	=	= 397	=	= 375	=	= 672	=
= 394	=	= 227	=	= 270	=	= 398	=	= 380	=	= 676	=

OBJECT SYNTHESIS -- CY01B

NAME (Print) _____ TESTING NUMBER _____
Last First Middle

GROUP _____ DATE _____

In each of the following items you will be given two objects. Your task is to think of something you could make by combining the two objects. For exampse:

Given: Nail and a cane ? _____

You could make a paper picker or a spear as the result of one way of combining the objects. You could make a hook, if the objects were combined in another way.

Given: Volley ball steel spring punching bag

One answer that might serve has been written in the answer space above.

The objects given should be sufficient in themselves to make the new object. You should not use objects other than those stated. Be sure to use both of the original objects in making the new object.

The test is divided into two parts of 12 items each. You will be allowed 5 minutes for each part. Only one answer is required for each item. Work rapidly. If you have trouble with any item, go on to the next one. You may come back to those not answered if time permits, but do not return to Part 1 after starting on Part II.

Are there any questions?

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

PART I

1.	sheet of paper	glue	_____
2.	push broom	coat	_____
3.	clamshells	shoelace	_____
4.	paper clip	playing card	_____
5.	wire coathanger	newspaper	_____
6.	rubber band	oak leaf	_____
7.	manhole cover	chain	_____
8.	wire	powderpuff	_____
9.	needle	clothes pin	_____
10.	wire coathanger	rock	_____
11.	brick	dish towel	_____
12.	rubber sponge	screw	_____

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

PART II

13.	screwdriver	rag	_____
14.	pliers	shoestring	_____
15.	cellophane	candle	_____
16.	hairpin	button	_____
17.	golf club	necktie	_____
18.	safety pin	string	_____
19.	inner tube	barrel	_____
20.	key chain	stick	_____
21.	cork	spring	_____
22.	cotton	scissors	_____
23.	window pane	tin foil	_____
24.	thread spool	nail	_____

L. L. Thurstone
The University of Chicago

PUNCHED HOLES

NAME_____ TESTING NUMBER_____
(print) Last First Middle

GROUP_____ DATE_____

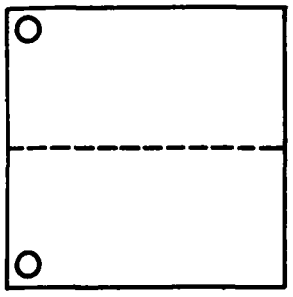


Figure 1

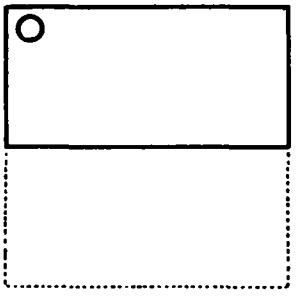


Figure 2

Figure 1 represents a square sheet of paper. It is folded on the dashed line and then it looks like figure 2. A hole is punched through the folded paper as shown in figure 2. Show by small circles in figure 1 where the holes would be when the paper is unfolded. The small circles have been drawn for you in this example.

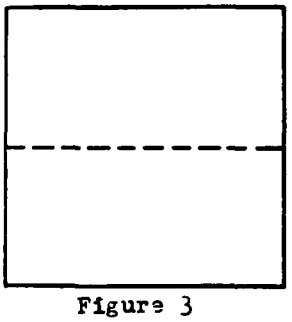


Figure 3

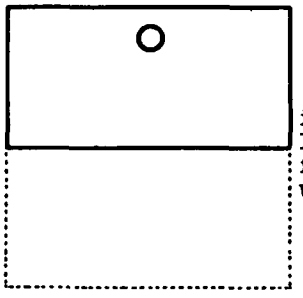


Figure 4

Figure 3 is another sheet of paper. When it is folded along the dashed line, it looks like figure 4. A hole is punched as shown in figure 4. Show in figure 3 where the holes would be when the paper is unfolded.

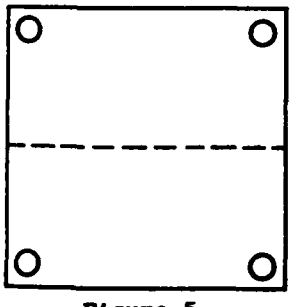


Figure 5

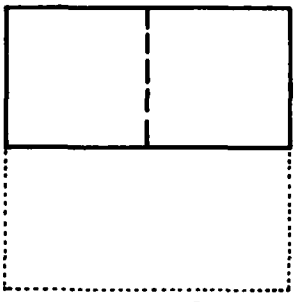


Figure 6

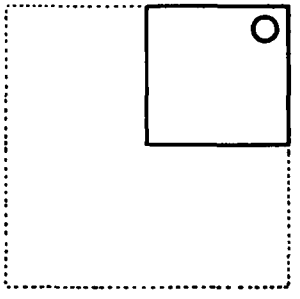
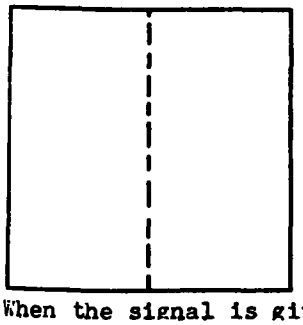
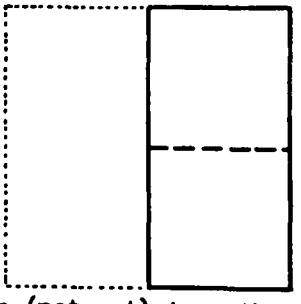
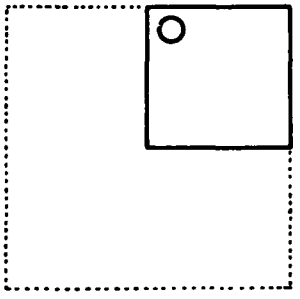


Figure 7

Figure 5 is a sheet of paper which is folded along the dashed line. Then it looks like figure 6. It is folded once more and then it looks like figure 7. A hole is then punched through it. Show in figure 5 where the holes will be when the paper is unfolded. The holes have been marked for you in this example.



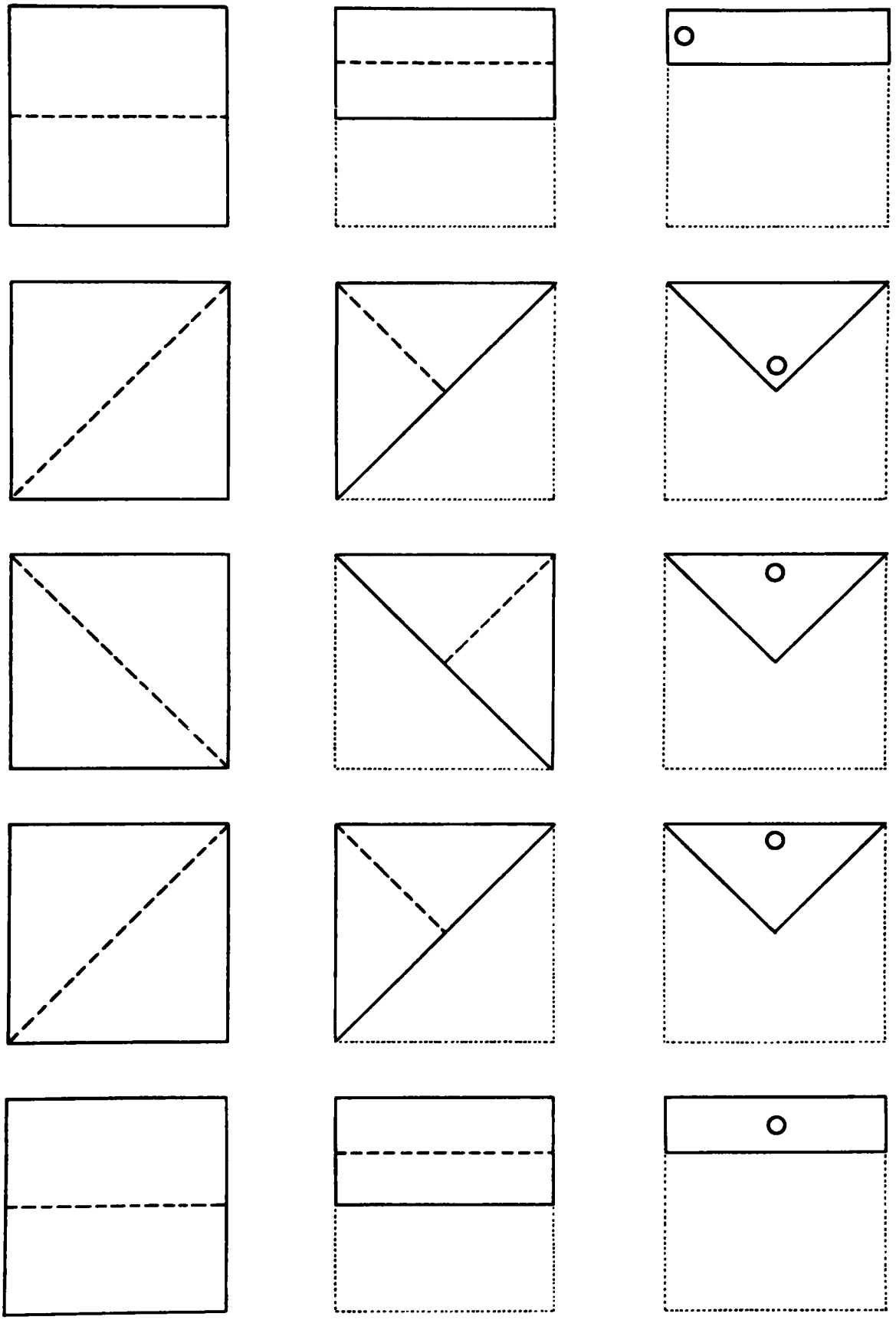




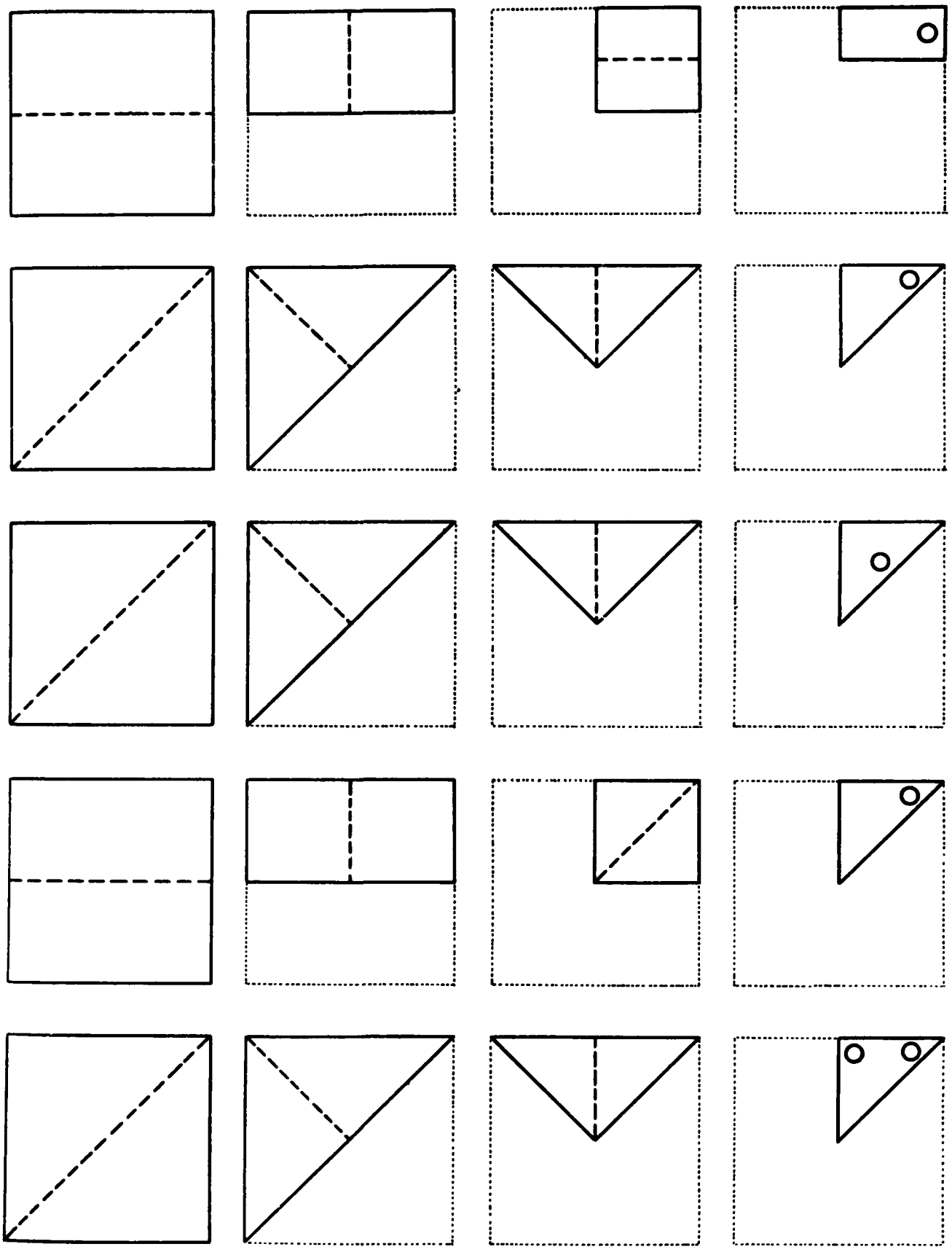
These diagrams represent in the same manner a sheet of paper that is folded twice. A hole is then punched through it. Show by small circles in the first square where the holes will be when the paper is unfolded.

When the signal is given (not yet) turn the page and do others like these. WAIT FOR THE SIGNAL.
Be sure to record your answer to each item in the square at the left. You will have 6 minutes working time for this test.

Show in these squares where the holes will be.



Go to the next page. Do not wait for any signal.



APPENDIX 1

SENTENCE ORDER -- RP04B

NAME (Print) _____ TESTING NUMBER _____
Last First Middle

GROUP _____ DATE _____

Each of the items in this test is made up of three sentences like these:

2 She bought some food at the market.

3 She returned home and cooked some of the food she had bought.

1 She went to the market.

The three sentences are not in a sensible order. Clearly, she would first have to go to the market, then buy food, and then return home and cook the food. Thus, in order to make sense, the sentences would have to be rearranged in this way:

She went to the market.
She bought some food at the market.
She returned home and cooked some of the food she had bought.

The item shown above has therefore been answered by writing a "1" before the sentence that should come first, a "2" before the sentence that should come second, and a "3" before the sentence that should come third.

Now read the next sample item and decide what the order of the three sentences must be for them to make sense. Place a "1" before the sentence that should come first, a "2" before the one that should come second, and a "3" before the one that should come third.

____ He dressed and hurried to work.

____ He worked hard and was tired when he got home that evening.

____ He woke up when the alarm rang.

You should have numbered the three sentences 2,3, and 1, because he would first wake up, then dress and hurry to work, and later be tired after working hard.

There are two parts to this test; each part consists of 10 items. You will have 3 minutes per part. You will have to work rapidly in order to finish each part. Are there any questions?

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

1. ____ The gunmen ran out of the bank as the cashier shouted that he had been robbed.

____ The gunmen got away in the stolen car.

____ The gunmont stopped a passing car and ordered the driver to get out.

2. ____ The warmth of the fire made them sleepy.

____ They built a fire.

____ As the hours passed it seemed to be getting colder in the room.

3. ____ The butterfly flew gracefully toward him.

____ A butterfly appeared and hovered briefly over one of the flowers.

____ He checked his net in case he saw any butterflies.

4. ____ The cat was released for a time then was returned to the box where he sat quietly.

____ Immediately when put into the box the animal bit the loop repeatedly without pulling.

____ He went to the loop, took the string in his teeth and pulled, opening the door.

5. ____ Bill had to stop his car right next to signposts in order to see the street names.

____ Bill could see the color of the traffic signal blocks away with his new glasses.

____ Bill barely passed the eye test for his driver's license.

6. ____ As he approached, he saw that she was reading a book.

____ She was sitting on the porch with her back to the road.

____ Only her head and shoulders could be seen.

7. ____ They were very much frightened but did not stop.

____ They kept hearing straing noises as they approached the barn.

____ They stole quietly towards the barn.

8. ____ Many roads were blocked and houses flooded.

____ The river overflowed because of heavy rains.

____ Traffic was held up in the area.

9. ____ Part of the wastage of the materials was due to individual carelessness.

____ Some of the people who used the materials did not try to conserve them.

____ A study showed that about 40% of the materials was wasted.

10. ____ The elevator went slowly up to the fifth floor.

____ At the fourth floor a passenger boarded and the elevator started to descend.

____ An insistent buzzer indicated someone on the fifth floor was in a hurry to go down.

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

11. ____ He noticed that some changes had been made.

____ The stage was much larger and there were about twice as many seats.

____ He had been to this theater many years before.

12. ____ In the evening, his aunt took him with her for a walk.

____ It was after sunset but still not dark.

____ The window panes of the houses they walked past shone with a dim golden light.

13. ____ The sun's glare prevented our seeing who was leading.

____ Jim stumbled when the shot was fired.

____ Jim came in second in the race.

14. ____ He did not hear him and started for the front door.

____ He pushed through the back door and listened for him.

____ He looked into the bedroom as he walked by to see if he was there.

15. ____ He confessed that he had committed the crime.

____ Evidence was found to show that he was telling the truth, and new arrests were made.

____ He claimed others helped.

16. ____ They looked about them and discovered that they were lost.

____ After the picnic they went for a walk.

____ They had a long discussion.

17. ____ The people outside the courthouse received the news in shocked silence.

____ Someone rose and spoke excitedly to the angry crowd.

____ The prisoner was freed for lack of evidence.

18. ____ The road became wider and there were more trees.

____ Further out, there were almost no houses to be seen.

____ As they walked beyond the church the scenery changed.

19. ____ He takes a rest and sits down again at the table.

____ He may sit as long as half an hour and still find nothing, then all at once the decisive idea presents itself.

____ Often a man accomplishes nothing the first time he sets to work at a difficult question.

20. ____ When he came home for dinner, his uncle was not yet there.

____ From a front window he saw his friends playing below in the street.

____ He sat staring at the clock for a while and then went upstairs.

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

APPENDIX 1

SIGN CHANGES -- CXO4B

NAME (Print)_____ TESTING NUMBER_____
Last First Middle

GROUP_____ DATE_____

This is a test of your ability to do simple arithmetic operations in which you have to substitute arithmetic signs. In the items on the following pages, you will be asked to substitute one kind of arithmetic operation sign for another before performing the operation. For example:

In the following problems, wherever you see:

\- replace it by x
\+ replace it by -

3 - 6 = 18

6 + 2 = _____

4 - 3 = _____

The answer for the second item should be 4 and for the third item, 12. Notice that wherever the - sign occurs in the problems you should replace it with x and perform a multiplication. Wherever the + sign occurs, you should replace it with - and perform a subtraction.

In each group of items on the following pages, you will be told what substitutions to make. The substitutions will be different from those given in the sample above and will change for each new group of items.

This is a speed test so work as rapidly as you can. You will have 20 seconds for the first group of items.

When the signal is given (not now), you may turn the page and begin. Remember that the substitutions will change for each group of items. Are there any questions?

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

APPENDIX 1

Part I

In the following problems wherever you see:

x replace it by ÷

÷ replace it by x

\+ replace it by -

\- replace it by +

2 - 1 = _____

3 ÷ 2 = _____

8 - 4 = _____

4 x 2 = _____

6 + 5 = _____

8 x 2 = _____

7 ÷ 3 = _____

5 + 2 = _____

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

APPENDIX 1

Part II

In the following problems wherever you see:

- replace it by $\div$
x replace it by -
+ replace it by x
$\div$ replace it by +

4 x 1 = _____

6 = 6 = _____

5 $\div$ 3 = _____

3 x 2 = _____

2 + 5 = _____

6 - 3 = _____

7 $\div$ 4 = _____

8 - 4 = _____

In the following problems wherever you see:

+ replace it by $\div$
x replace it by +
- replace it by x
$\div$ replace it by -

3 - 2 = _____

1 $\div$ 1 = _____

8 + 4 = _____

5 - 4 = _____

2 + 2 = _____

4 x 2 = _____

8 $\div$ 7 = _____

6 x 1 = _____

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS

APPENDIX 1

Part III

In the following problems whcrever you see:

x replace it by ÷

\+ replace it by x

\- replace it by +

÷ replace it by -

8 - 1 = _____

5 + 2 = _____

6 ÷ 5 = _____

4 + 6 = _____

8 x 2 = _____

7 ÷ 2 = _____

6 - 2 = _____

6 x 3 = _____

In the following problems wherever you see:

÷ replace it by x

x replace it by +

\+ replace it by -

\- replace it by ÷

7 x 5 = _____

9 + 3 = _____

4 ÷ 7 = _____

6 x 2 = _____

6 - 2 = _____

8 + 2 = _____

8 - 4 = _____

7 ÷ 8 = _____

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

APPENDIX 1

WORD - GROUP NAMING - RCSO2B

NAME (Print)_____ TESTING NUMBER_____

GROUP_____ DATE_____

Each item in this test is a list of five words that are all alike in some way. Your problem is to find a name for each list. Read the following list of words:

knife pan bowl
rolling pin strainer

cooking utensils

All of these things are used in preparing food, so a good name for the group is "cooking utensils" and this answer has been written in the space below the list. Other correct answers would be "cooking equipment" or "things used to cook." It would not be correct to call the list "housekeeping things", or "hardware," or "things to use" because these names are too broad and general and include a lot of kinds of things that are not in the list.

Now read the following sample item and write your answer in the space below it. Think of the best name for the whole list.

volcano oven Africa
fire sun

_____

You should have written "hot things" or "warm things" or a similar term.

When the signal is given (not yet), turn the page and do more items of the same kind. The test is divided into two parts of 15 items each. You will have five minutes for each part. Work rapidly but try not to make mistakes. Look for the best name for each list of words. Do not spend too much time on any one item.

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

APPENDIX 1

PART I

1.	movie	game	carnival	8.	nail	rivet	zipper
	bowling	circus			screw	fork	
2.	lake	bay	creek	9.	box	skip	jump
	pool	puddle			wrestle	write	
3.	window	water	spectacles	10.	house	shoes	umbrella
	air	drinking glass			blanket	armor	
4.	banana	lemon	sunflower	11.	pencil	leg	fencepost
	grapefruit	gold			tree	broom	
5.	skin	ear	nose	12.	novel	dragon	dream
	eye	mouth			cartoon	mirage	
6.	moth	mosquito	swallow	13.	blindness	hunger	deafness
	bat	airplane			feeblemindedness	bankruptcy	
7.	buying	making	stealing	14.	speech	roar	groan
	finding	taking			music	thunder	

15. pencil needle pick
steeple nail

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

PART II

16. glue nail button screw rivet

17. love hate respect jealousy excitement

18. wood stone brick steel concrete

19. cream fat wood cork foam

20. cup frying pan gas tank salt shaker wastebasket

21. actress sculptor violinist pianist designer

22. mouse spider rat mosquito grasshopper

23. vase earring cameo girl flower

24. election track meet chess prizefight debate

25. morning infant preface cadet kindergarten

26. slab cube sphere pyramid cylinder

27. actress cow spinster queen hen

28. glue honey syrup milk coffee

29. astronomer spy audience witness inspector

30. horizon fence shore hem curb

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

APPENDIX 2

SCORING CRITERIA FOR THE CONVERGENT-THINKING TESTS

Camouflaged Words

Scoring: One point for each correct answer.

Part I	Part II
1. golf	11. rugby
2. track	12. football
3. race, handball, ball	13. bingo
4. badminton	14. hockey
5. pitch, chess	15. bridge
6. race, boxing	16. racing
7. pole	17. fishing
8. sailing	18. archery
9. casino	19. lacrosse
10. darts	20. pool

Correlate Completion II

Scoring: One point for each correct answer.

Part I	Part II
1. aide	21. my
2. to	22. name
3. by	23. emit
4. bag	24. cow
5. star	25. mane
6. far	26. lord
7. put	27. drear
8. law	28. mat
9. stunt	29. flies
10. start	30. sill
11. fore	31. gnat
12. tie	32. stall
13. scale	33. tale
14. tows	34. open
15. item	35. seat
16. raid	36. eat
17. sing	37. ping
18. ally	38. jut
19. foe	39. prig
20. fret	40. no

APPENDIX 2

Inventive Opposites

Scoring: One point for each correct answer.

Part I

1. difficult	hard
2. wealthy, wealth	riches, rich, resourceful
3. lie	fiction, falsehood, fib, falsity, fable
4. dirty, dusty, defiled	sooty, smudgy, squalid, sullied, stained, soiled, sordid
5. horrible, horrid, homely, hideous	unattractive, unsightly, ugly
6. tame, timid, tender	meek, mild, moderate, manageable
7. silent, still, secretive, speechless	quiet
8. separate, scatter, split, strew, sever, sunder, spread	divide, divorce, disjoin, detach, disconnect, disperse, diffuse, distribute, dissect, disassemble, dwerge
9. moderate, mild, meager, measly, minimum	temperate, tempered
10. delicate, dainty	fine, finished, fragile
11. elaborate, extreme, extra, extensive, excessive, extravagant, exorbitant, enormous, effusive	intense, immense, infinite, inordinate, intemperate
12. insincere, imposter, imitated, imitation	unreal, unadulterated, unauthentic

Inventive Opposites (Cont'd.)

Part I

13.	peace	harmony
14.	honorable, hallowed, holy, honest	upright, unstanding
15.	hazard, harm	danger

Part II

16.	loquacious, loud	noisy
17.	cheerful, content, cheery, clear	happy, hearty, hopeful
18.	expensive, extravagant	costly
19.	distant	far
20.	courteous, chivalrous, cultivated, cultured, civil, correct, considerate, congenial	polite, proper
21.	torrid, thawed	hot, heated
22.	sad, sorrowful, solemn, subdued, saddened, small	downcast, dejected, deflated, disappointed, disconsolate, depressed, defeated, down, despondent, downfallen, discouraged, downhearted
23.	accurate, authentic, absolute	correct
24.	conceited, crowing, cocky	bold, boastful, bragging, brash, brazen
25.	able, adequate, accomplished	sufficient, skillful, successful, suitable, satisfactory, sure
26.	scrupulous, saintly, sincere, straight-forward	honest

Inventive Opposites (Cont'd.)

Part II

27.	elated, earnest, eager, excited, energetic, engrossed, enthusiastic	inquiring, inquisitive, interested
28.	hoard, hold, have, hog	save, scrimp, store
29.	fixed, found, final, forever, fast	proven, proved, permanent, perpetual, positive
30.	arousing, arresting, appealing, adventurous, agitating, amusing, alluring, awakening, attractive	entertaining, electrifying, enchanting, engrossing, eventful, enjoyable, enthralling, exciting, engaging, exhilarating, elating

Form Naming

Scoring: Time required to name one hundred random geometric figures.

Numerical Operations, Part III

Scoring: Scoring stencil is supplied by the Sheridan Supply Company, Beverly Hills, California.

Object Synthesis

Scoring: Acceptable responses must fit the following three criteria:

1. That both objects are used and are necessary in making the new object;
2. The objects given should be sufficient in themselves to make the new object;
3. Objects other than those given should not be necessary or used in making the new object.

The total score is the number of acceptable responses given. Sample acceptable and non-acceptable responses are given below.

Object Synthesis (Cont'd.)

	Acceptable Responses	Non-Acceptable Responses
1.	Paper playhouse envelope cup paper hat paper box, basket fly paper note pad paper type book cover flower sack mask pin holder bulletin board paper cone, cylinder pattern airplane glider target funnel paper doll package wrapping tag to put on locker paper boat	kite flag pin wheel party favor a child's toy cardboard model
2.	scarecrow mop wall wiper dummy dust mop street cleaner	coat-rack sail street-cleaner's uniform
3.	necklace bracelet, belt watch pendulum castanets purse wampum change holder suspended ash tray wall decoration earrings sling Xmas tree decorations watch fob doorknocker	dipper earmuffs flower pot containers souvenir musical instrument box vase tray table fixture jewelry

Object Synthesis (Cont'd.)

	Acceptable Responses		Non-Acceptable Responses
4.	tag	pea shooter	display
	clipboard	napkin holder	cardtrick
	place card	cylinder	toy
	bookmark		cutouts
	mobile		ash tray
	spinner		pocket prot.
	noisemaker for bicycle		straw
			picture
	money holder		small tent
	airplane		musical instrument
	target		fountain pen
	fan		card house
5.	flag	tent	padded coathanger
	kite	umbrella	newspaper stand
	torch	skirt	hat
	pants hanger	fan	drying hanger
	doll house	basket	flower
	paint strainer	brush	coat
	sun shade	fly swatter	falseface
	waste container		cake cover
	lamp shade		sign
	wind direction indicator		statue
	hoop for dog trick		
	clothes line		
6.	sling shot		name tag — spy glass
	bandage		rubber ball — water scoop
	flipper		airplane — ming tree
	brush		flying or falling leaf
	sun visor		insulator
	fig leaf decoration		wind director
	hair decoration		sealed envelope
	table ornament		plug
	necklace, bracelet		gift wrapping for corn
	target		sail boat
	light pull		curio
	corsage		toy, toy boat
	cigarette, cigar holder		cradle
	tube		fan
			boat decoration
			whistle

Object Synthesis (Cont'd.)

	Acceptable Responses		Non-Acceptable Responses
7.	anchor	counterweight	paper weight
	swing	hobble for animal	stand
	gong	battering instrument	key chain
	fire alarm	dirt spreader	elevator
	sinker	ornamental shield	club
	hoist		
	leg iron		
	drag		
	pendulum		
	lawn pounder		
	large medallion		
8.	swab	dauber	stiff upper lip
	duster	toy animal	bunny tail
	paint brush	coaster	gun cleaner
	ear muff	stopper	ball-fly for fish
	knee pad	target	wind-direction finder
	polisher	tree	pin cushion
	gun cleaner	doll	umbrella
	polish shoes	false flower	decoration
	back scratcher		powderpuff with wire handle
	"dodger"-darkroom		some sort of signal
			metal scraper
9.	scratch awl	holding insect (specified)	toy doll
	dart		paddle-wheel boat
	punch		windmill
	paper holder		thread winder
	spear		water level indicator
	small paper picker		fastener (not specified)
	pick		something to prick end of finger
	scriber		ice pick
	noteholder		weather vane
	towel dryer		hook
10.	pendulum	bell clapper	weapon (without specifying)
	sling	club	weight (without specifying)
	anchor	fishing pole holder	
	blackjack	sinker	
	hammer	doorstop	
	tomahawk	trail marker	
	suspended weight		

Object Synthesis (Cont'd.)

	Acceptable Responses		Non-Acceptable Responses
11.	foot warmer	ice crusher	bag
	bed warmer	paper weight	weapon (without specifying)
	marker	blackjack	sinker
	pillow	club	dish washing stand
	doorstop	mallet	dust cover for dainty glass
	bookend	scrubber	
	floor polisher		
12.	door stop		pen cleaner
	cushion		dehydrator
	glass washer		stationery sponge
	stamp wetter		soap dish
	shoe scrapper		pin cushion
	shock absorber		hand wiper
	a perm.blotter		
	nonslip base		
	noiseless fastening pad for bottom desk		
	wax applicator		
13.	water plug, stopper	paint brush	plumb bob
	swab	ice crusher	pendulum
	gun barrel cleaner	oil sop	tool kit
	flag	wood scraper for gun,etc.	pistol
	small mop	pipe cleaner	spark plug tester
	rag doll	probe to clean hard-to-get places	torch
	tourniquet		paint mixer
	black jack		
14.	plumb bob	muscle builder	perm. pinchers
	pendulum	clamp whip trap	chain link
	vise	lock wrench	frustrated wrestler
	tension pulley	war club	black jack
	toy anchor	tongs	
	article re-retriever		
	turnbuckle		
	a tool you can't drop		
	door knock		
	thumb screw		
	muscle builder		

Object Synthesis (Cont'd.)

	Acceptable Responses		Non-Acceptable Responses
15.	lamp, lantern	waterproof, windproof light	candle holder
	signal light, flare	Xmas decorations	Easter egg
	centerpiece	wax paper fuse	fire
	artificial candy cane		fuse
			decoration
			smoke
			deodorizer
			fire trap stinkbomb
			mess
			whistle
			waterproof bag
16.	cotter pin	ring	display
	child's toy	key chain	book marker
	eye for rag doll	circle marker	fish hook
		upholstery tie	game
	sink stopper	staple	ornament
	wheel & axle for toy	plug	toy (without specifying)
		cuff link	top lock picker
	tie pin, clasp	latch	button hanger
	balance on scale		handle fastener
			slingshot
	cake decor.		doll
	gun sight		spare button on dress
	paper catch file or paper spike		
17.	flag marker	ski pole	pendulum
	splint	whip	fishing pole
	bow for shooting arrows	lever	balance scales
		playhorse	man's gift
	small game snare	crutch	cane
			tourniquet
	rescue line		quirt
	raincoat hanger		stick
	retrieving loop		duster
			tie rack
			paddle club
			swing
18.	fishline & hook	light cord	plumb bob
	measuring line	towel holder	pendulum
	hanger	connector	tying bags
	watch chain, fob	door fastener	small swing
		key chain	draw string
	garter	baby rattle holder	belt
	needle & thread		toy
	hook to get things from tight places		leash
			lasso

Object Synthesis (Cont'd.)

	Acceptable Responses		Non-Acceptable Responses	
19.	child's swing	rocking horse	water tank	
	raft	Mae West pre-	pendulum	
	float	server	sling shot	
	drum, tom-tom	round boat	rain barrel	
	skiis	bumper	floating barrel	
	device for chil-	chair	football tackle dummy	
	dren to use in		icebox	
	water			
20.	fishing pole	compass	baton	plumb bob
	tether for	whip	cane	toy
	animal	balance	hoop	scale
	tourniquet	billy club	trap	
	night stick	window hook	weapon (without specifying)	
	fish stringer		walking stick	
	door catch			
21.	fishing float	plug stopper	cork screw	
	jack-in-box	napkin holder	light switch	
	door stop	in drawer	pad	
	cork gun		toy bird	
	shooter		vibration indicator	
	booby trap device		balance	
	letter holder		pull toy	
	positive seal		homemade coil	
	bottle cap holder			
22.	swab		first aid kit	pipe cleaner
	mask		thread	
	"snowman"		bandage	
	doll		pattern	
	toy soldiers		artificial snow	
	something to clean		padding for chair	
	dogs' ears		shawl	
	suture		patch	
			protect fingers while cutting	
23.	condenser	picture	smooth tinfoil	
	mirror	palette	hot plate	
	reflector	Xmas decor.	stove	
	knife		oven	
	shelf		darkened room	
	desk cover		window blind	
			display	
			flower box	
			weather stripping	

Object Synthesis (Cont'd.)

Acceptable Responses	Non-Acceptable Responses
24. pulley	hook
wheels	bobbin
noisemaker	fishing float
door knob	mechanical machine
reel	tool holder on wall
insulator	soil scratcher
plumb bob	bumper
paper	
holder	
door handle	
limited depth punch	
paper punch	
roller	
door stop	
kite string holder	
fish line drill	
large thumbtack	
legs for flower pots	
leg extension	

Punched Holes

Scoring: One point for each correct solution. A sample answer key is enclosed.

Sentence Order

Scoring: One point for each correct sequence. No partial credit is given on this test.

1.	1, 3, 2.	11.	2, 3, 1.
2.	3, 2, 1.	12.	1, 3, 2.
3.	3, 2, 1.	13.	2, 1, 3.
4.	2, 1, 3.	14.	2, 1, 3.
5.	2, 3, 1.	15.	1, 3, 2.
6.	3, 1, 2.	16.	3, 1, 2.
7.	3, 2, 1.	17.	2, 3, 1.
8.	2, 1, 3.	18.	2, 3, 1.
9.	2, 3, 1.	19.	2, 3, 1.
10.	3, 1, 2.	20.	1, 3, 2.

L. L. Thurstone
The University of Chicago

PUNCHED HOLES

NAME_____ TESTING NUMBER_____
(print) Last First Middle

GROUP_____ DATE_____

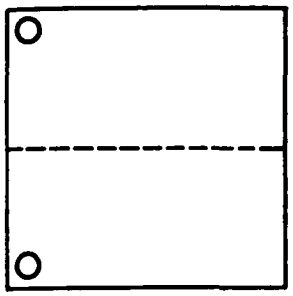


Figure 1

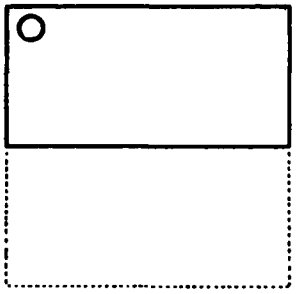


Figure 2

Figure 1 represents a square sheet of paper. It is folded on the dashed line and then it looks like figure 2. A hole is punched through the folded paper as shown in figure 2. Show by small circles in figure 1 where the holes would be when the paper is unfolded. The small circles have been drawn for you in this example.

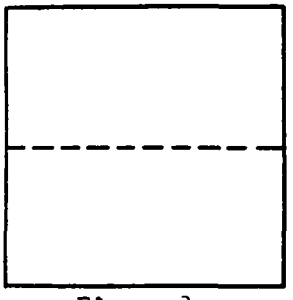


Figure 3

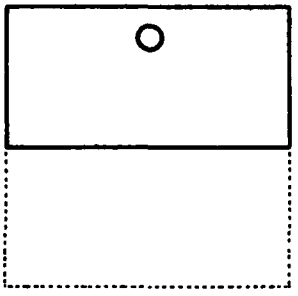


Figure 4

Figure 3 is another sheet of paper. When it is folded along the dashed line, it looks like figure 4. A hole is punched as shown in figure 4. Show in figure 3 where the holes would be when the paper is unfolded.

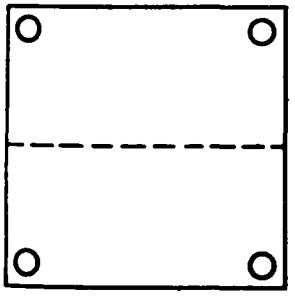


Figure 5

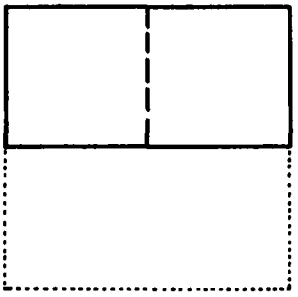


Figure 6

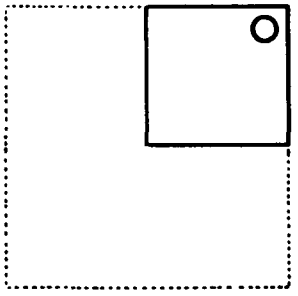
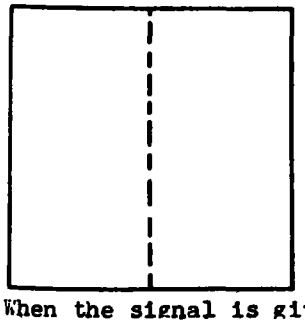
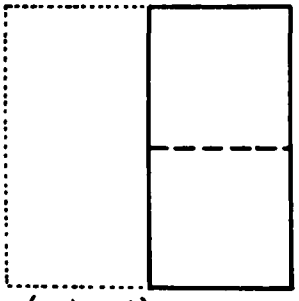
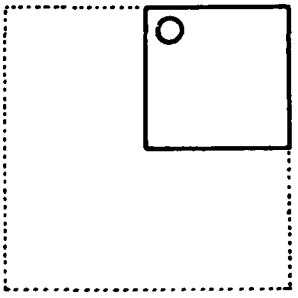


Figure 7

Figure 5 is a sheet of paper which is folded along the dashed line. Then it looks like figure 6. It is folded once more and then it looks like figure 7. A hole is then punched through it. Show in figure 5 where the holes will be when the paper is unfolded. The holes have been marked for you in this example.





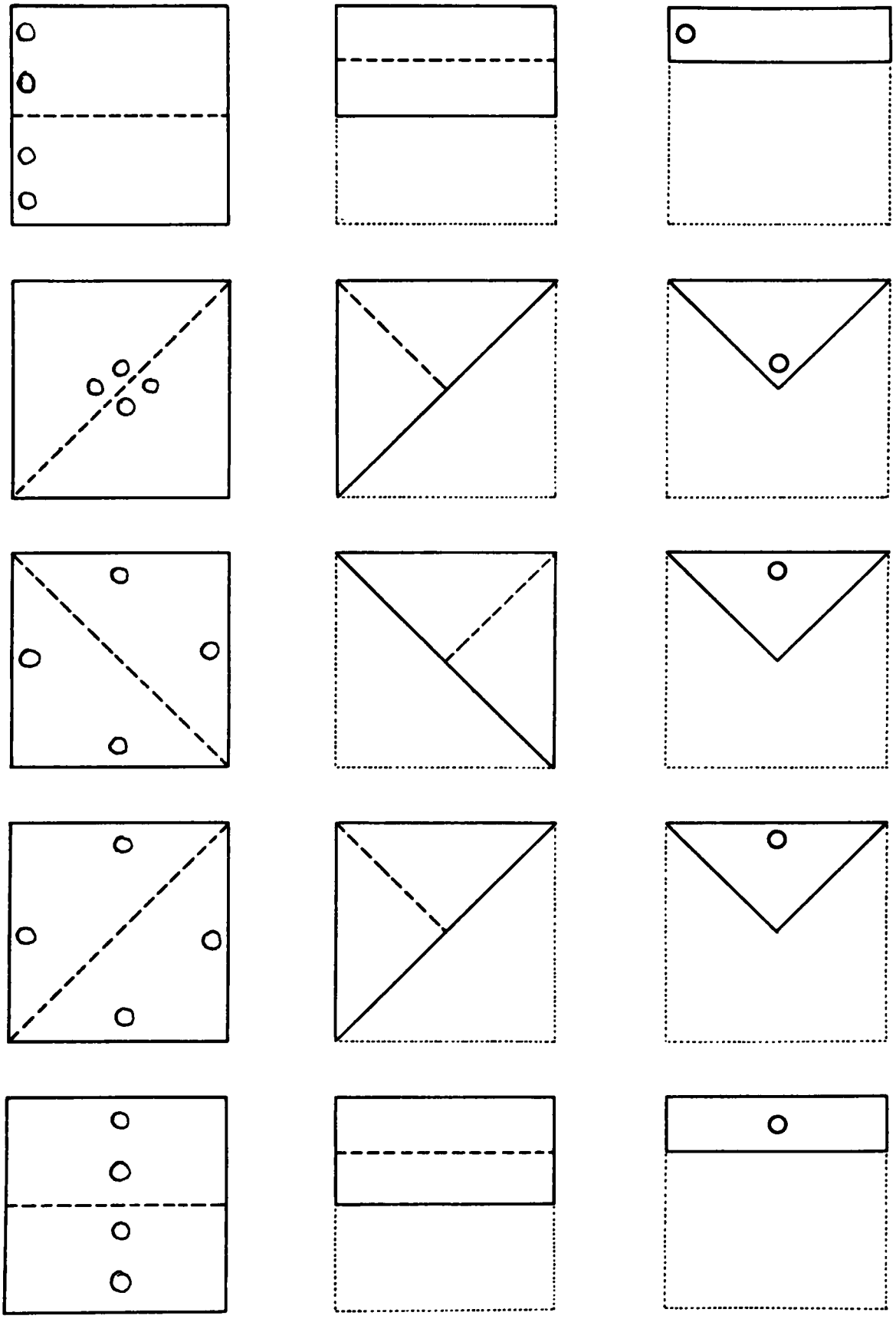


These diagrams represent in the same manner a sheet of paper that is folded twice. A hole is then punched through it. Show by small circles in the first square where the holes will be when the paper is unfolded.

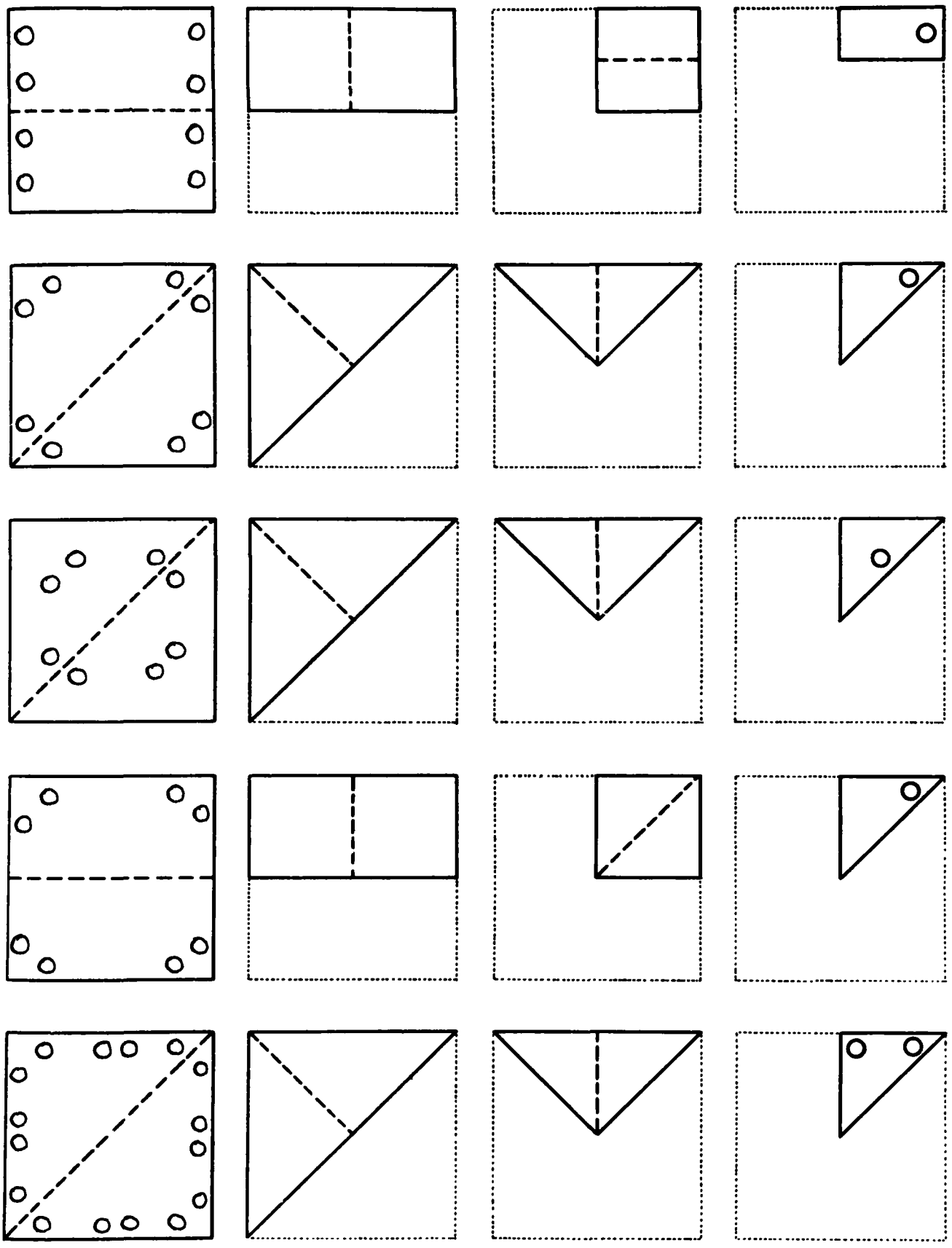
When the signal is given (not yet) turn the page and do others like these. WAIT FOR THE SIGNAL.

Be sure to record your answer to each item in the square at the left. You will have 6 minutes working time for this test.

Show in these squares where the holes will be.



Go to the next page. Do not wait for any signal.



APPENDIX 2

[illegible]

Scoring: Part I is a practice exercise. The total score is the number of correct answers on Part II and Part III.

Part II		Part III	
1.	3	17.	9
2.	36	18.	10
3.	8	19.	1
4.	1	20.	24
5.	10	21.	4
6.	2	22.	5
7.	11	23.	8
8.	2	24.	2
9.	6	25.	12
10.	0	26.	6
11.	2	27.	28
12.	20	28.	8
13.	1	29.	3
14.	6	30.	6
15.	1	31.	2
16.	7	32.	36

Word-Group Naming

Scoring: The total score is the number of acceptable class responses given on Part I and Part II. The class responses given should not be too general. They should represent the most specific class which will include all the given objects. It is advisable to score one item for all the papers before proceeding to the next item. Sample acceptable and non-acceptable responses are given below.

Part I

	Sample Acceptable Responses	Non-Acceptable Responses
1.	amusement, entertainment, recreation	enjoyable, pleasant things
2.	water (bodies of), place where water collects, water sources	wet things, country scenes
3.	transparent, translucent, can see through, clear object	without color, pertaining to glass and water

Word-Group Naming (Cont'd.)

Part I

	Sample Acceptable Responses	Non-Acceptable Responses
4.	yellow	things coming from the earth, products of nature
5.	sense organs, sensitive organs, five senses	parts of the head, organs of the body
6.	flying, winged	aerial things, airborne things
7.	acquiring, obtaining ways to procure	business practices
8.	retainers, fasteners, binders, holding, attaching, to secure, connecting, joining	metal things, work on friction principle
9.	activities	arm movements, indoor sports
10.	protective coverings, protector, things to shield us	types of shelter, go in or under
11.	straight, cylindrical, elongated, long and thin, long and slender	wooden, support
12.	imaginary things, make believe, fiction, things unreal	hallucinations, abstract things
13.	deficiencies, lack of something	trouble, loss of something
14.	sounds, audible, noise	loud
15.	pointed, sharp pointer, pointed tip, tapered at the end	long, narrow, utensils of work

Word-Group Meaning (Cont'd.)

Part II

	Sample Acceptable Responses	Non-Acceptable Responses
16.	fasteners, binding, securing, holders, joiners	household things, sticking things
17.	feelings, emotions	personality adjustment, marriage
18.	construction material, building material	solid objects, strong material
19.	float, lighter than water, buoyant	soft materials, porous objects
20.	containers, holders, receptacles, vessels	hardware, kitchen items
21.	artists, artisans	creative occupations, professions
22.	vermin, pests, house pests, varmint	animals, all are small
23.	decorations, ornamental	good-looking, feminine objects
24.	contests, competitions	group functions, exciting activities
25.	beginning, starting	things which precede, preparatory stages
26.	three-dimensions, solids, geometric solids	volume, geometric figures
27.	females	types of women, ladylike
28.	fluids, liquids	things that stain, wet substances
29.	observers, lookers on, viewers, watchers, spectators	people who scrutinize, have information
30.	edges, boundaries, border, limit	confinement, dividing points

Characteristics of the Convergent-Thinking Tests[a]

Name of Test	Name of Factor	Factor Loading	Reliability	Number	Originator
Camouflaged Words	Structural Redefinition	.34	--[b]	--[b]	J.P.Guilford
Correlate Completion II	Eduction of Structural Correlates	.46	.76	110	J.P.Guilford
Form Naming	Object Naming	.41[c]	--[d]	119	R.S.Woodworth
Inventive Opposites	Eduction of Conceptual Correlates	.50	--[b]	--[b]	L.L.Thurstone
Numerical Operations, Part III	Numerical Facility	.50	.92	170	J.P.Guilford
Object Synthesis	Conceptual Redefinition	.31	.72	410	J.P.Guilford
Punched Holes	Visualization	.64	.90	283	L.L.Thurstone
Sentence Order	Ordering	.45	.56	364	J.P.Guilford
Sign Changes	Symbol Substitution	.65	.87	201	J.P.Guilford
Word-Group Naming	Concept Naming	.46	.68	210	J.P.Guilford

a Norman W. Kettner, An Information Summary of Studies of Thinking Abilities, Los Angeles, University of Southern California, 1955, ii-93 p.

b These studies were not completed at the time of publication.

c John B. Carrol, "A Factor Analysis of Verbal Abilities", in Psychometrika, Vol. 6, No. 3, 1941, p. 279-307.

d Not reported by John B. Carrol.

APPENDIX 4

ABSTRACT OF

Convergent-Thinking in Schizophrenic Patients[1]

Past research on schizophrenic thought processes suggests that cognitive functioning of schizophrenics differs essentially from normal subjects and that they demonstrate a generalized deficit with respect to these functions.

The purpose of this investigation is to determine whether schizophrenic cognitive functioning differs from normal cognitive processes in kind, or in degree, using a multidimensional approach.

Guilford's theory of the Structure of Intellect is used as the theoretical framework of this investigation. This theory is a factorial representation of cognitive functioning of the normal adult individual. Only those factors identified as convergent-thinking functions were considered in this study. Convergent-thinking activity refers to those cognitive tasks which almost always require one conclusion or answer.

Two hypotheses were advanced in this investigation:

1. There is no significant difference between the dimension accounting for the variance of convergent-thinking of normal and schizophrenic subjects.

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1 Gerald Sperrazzo, doctoral thesis presented to the School of Psychology and Education of the University of Ottawa, Ontario, October, 1961, vii-102 p.

2. There is no significant difference between the performance of normal and schizophrenic subjects on any of the convergent-thinking tests.

Ten tests of convergent-thinking which loaded highest on their respective factors were administered to thirty schizophrenic patients and thirty normal subjects who were matched for age, sex, education, and estimated I.Q. level. The data was analysed by the D-method of factoring for the first hypothesis and by the critical ratio test for the second hypothesis.

The first hypothesis was not rejected while the second hypothesis was rejected at the .01 level of confidence.

These results, therefore, indicate that the convergent-thinking activity of schizophrenic subjects does not differ in kind from normal subjects, but in degree. These results were interpreted in terms of Halstead's "P" factor which suggests that a process of cortical inhibition is operative in schizophrenics which may produce a generalized deficit in cognitive functioning.