

**FACTORS INFLUENCING ROTATION
ON THE BENDER-GESTALT PERFORMANCE
OF CHILDREN**

by Jerry B. Fuller

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Psychology and Education of the
University of Ottawa in partial
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for the Degree of Doctor of
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CURRICULUM STUDIORUM

Jerry B. Fuller was born at Jacksonville, Florida, September 16, 1932. He received the Bachelor of Arts degree in Psychology from Michigan State University, East Lansing, Michigan, in 1954. He received the Master of Arts degree in Clinical Psychology from Wayne State University, Detroit, Michigan, in 1957. The title of his essay was The Etiology of Juvenile Delinquency.

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INTRODUCTION

It has been noticed and shown that during the performance of the Bender-Gestalt test, many children would draw or reproduce the designs correctly but in a rotated position. Yet few studies on the Bender-Gestalt test report investigation of reasons as to why this distortion in reproduction occurs. However, one study has attributed it to brain damage and another to the regression phenomenon. Besides these studies no one has tried to explain or account for this rotation effect by children on the Bender-Gestalt test.

The present report presents the results of an experiment in which the investigator attempted to show that rotation on the Bender-Gestalt cards might be influenced by stimulus variation, cue utilization or a combination of the two.

The first chapter of the report presents the review of the literature. This chapter is divided into three sections. The first deals with children and maturation aspects. The second with the performance of emotionally disturbed and schizophrenic children. The last section is concerned with the performance of brain-damaged and mentally defective children on the Bender-Gestalt test.

Chapter II is concerned with the theoretical considerations of rotation. It is divided into two sections, one

dealing with stimulus variation and the other with cue utilization. The section on stimulus variation is further divided into the sub-headings: figure variation, ground variation and configuration.

The third chapter is concerned with a description of the experimental design. description of the subjects is presented and the instrument is discussed. The statistical approach used is also stated.

Chapter IV presents the results of the experiment and Chapter V attempts an adequate interpretation of the results.

In the last section of the report, a summary and conclusion is given and the possible implications, for further research, are suggested.

CHAPTER I

REVIEW OF THE LITERATURE

The Bender-Gestalt visual motor test was originally conceived as a visual-motor performance test to explore the gestalt function in perception.¹ In recent years there has been increased use and investigation of this test by psychologists and psychiatrists as a clinical instrument for the diagnosis of personality dynamics and psychopathology. More explicitly, it has been used to determine the relationship of Bender performance to organic disease, to maturation level, to psychosis, to neurosis, and mental deficiency. Since the publication of Bender's Monograph, research studies have been primarily concerned with the development of objective scoring systems, problems of interpretation, and validation. It would be beyond the scope of this paper to mention the numerous research studies that have been carried out in these areas.

In addition to standard instructions² other methods of administration have been developed, including

1 Laretta Bender, "A Visual Motor Gestalt Test and its Clinical Use", American Orthopsychiatric Association Research Monograph, No. 3, 1938, ix-176 p.

2 -----, Instructions for the Use of the Visual Motor Gestalt Test, New York, American Orthopsychiatric Association, 1946, 6 p.

the methods of elaboration,³ tachistoscopic exposure,⁴ haptokinetic form,⁵ and recall,⁶ which for the most part have been concerned with adult performance.

Until the last few years investigation of children's performance on the Bender test has been relatively limited and a review of these studies can adequately be treated under the following headings:

1. Children and Maturation Aspects;
2. Performance of Emotionally Disturbed and Schizophrenic Children; and
3. Performance of Brain-damaged and Mentally Defective Children.

1. Children and Maturation Aspects.

The earliest research with children centered around maturation. Bender⁷ obtained test records for eight hundred

3 M. L. Hutt, "Revised Bender Visual-Motor Gestalt Test", in A. Weider (ed.), Contributions Toward Medical Psychology, New York, Ronald Press, 1950, p. 660-687.

4 James Sacks, "A Study of Normal and Paranoid Schizophrenic Responses to Tachistoscopic Presentation of the Bender-Gestalt Test", Unpublished Master's Thesis, University of Chicago, 1950, 69 p.

5 B. Barkley, "A Study Comparing the Performance of Brain Damage Cases in the Bender-Gestalt Test and a Tactual Kinesthetic Version of the Same", Unpublished Doctoral Thesis, Western Reserve University, 1952, 149 p.

6 J. L. Hanvick and A. L. Anderson, "The Effect of Focal Brain Lesions on Recall and on the Production of Rotations in the Bender-Gestalt Test", Journal of Consulting Psychology, Vol. 14, 1950, p. 197-198.

7 Laretta Bender, op. cit., p. 112-136.

children and developed normative data for each age level from three to twelve years. She provided a series of tables by which the approximate age level for each of the nine figures could be estimated. However, information in these tables was neither sufficiently detailed nor in a form that was easily utilized as an objective estimate of the "maturation level" to which she referred. Despite this, her work has been corroborated by further research reported by Harriman and Harriman,⁸ Baldwin,⁹ Keller,¹⁰ and Pascal and Suttell.¹¹

2. Performance of Emotionally Disturbed and Schizophrenic Children.

Byrd's¹² investigation of the Bender Test relating to performance of children in need of psychotherapy has

8 M. Harriman and P.L. Harriman, "Bender-Gestalt Test as a Measure of School Readiness", Journal of Clinical Psychology, Vol. 6, 1950, p. 175-177.

9 M.V. Baldwin, "A Note Regarding the Suggested Use of the Bender Visual Motor Test as a Measure of School Readiness", Journal of Clinical Psychology, 1950, Vol. 6, p.412-415.

10 James Keller, "The Use of a Bender-Gestalt Maturation Level Scoring System with Mentally Handicapped Children", American Journal of Orthopsychiatry, Vol. 26, 1955, p. 563-573.

11 G. R. Pascal and Barbara J. Suttell, The Bender-Gestalt Test, New York, Grune & Stratton, 1951, x-274 p.

12 Eugene Byrd, "The Clinical Validity of the Bender-Gestalt Test with Children", Journal of Projective Techniques, Vol. 20, 1956, p. 127-136.

provided a basis for knowing what may be expected from emotionally disturbed as well as from emotionally healthy children on the test. He used two hundred normal children as well as two hundred in need of psychotherapy. Four factors which differentiated significantly between the performance of the two groups were rotation, change in curvature, orderly sequence, and closure difficulties. Rotation occurred at all ages above nine and collision occurred only at the ages of fourteen and fifteen. Byrd found there was a great deal of overlap between the various age groups and cautioned against evaluation of a record on the basis of a sign approach alone. The major defect of his study was failure to investigate the interpretation of differentiating variables.

In a study of fifteen schizophrenics, fifteen retarded (familial), and fifteen normal children all ranging in age from eleven to sixteen years, Goldberg¹³ found that while there was a significant difference between the normal group and the abnormal groups combined, there was none between the schizophrenic and retarded groups. The retarded group tended to produce small figures in rigid pattern, used primitive loops, rotated the figures, and demonstrated uneven

¹³ Franklin H. Goldberg, "The Performance of Schizophrenic Retarded and Normal Children on the Bender-Gestalt", American Journal of Mental Deficiency, Vol. 61, 1957, p. 546-555.

line quality. In agreement with Bender's¹⁴ observations, it was found that the schizophrenic group usually elicited an unpatterned sequence, enlarged designs, rotation and perseveration. Some of the patterns of the schizophrenic records which she described were also representative of the drawings of the retarded children, which included the tendency toward rotation and the use of circles instead of dots. No interpretive basis for his qualitative findings were submitted by the author.

Clawson¹⁵ compared the performance on the Bender of eighty emotionally disturbed children with eighty normal children in the age range from 7 to 12 years. The latter group was found to be more accurate in their performance. Clawson found that the thirteen most significantly discriminating factors were order of sequence, use of white space, change in size, closure, regression, rotation, change in angulation, change in curvature, incorrect number of units, direction of drawing, erasure, separation, and workover.

Byrd¹⁶ had previously found seven of these factors to differentiate between his two groups and helped verify the

14 Laurretta Bender, Child Psychiatric Techniques, Springfield, Illinois, Charles C. Thomas, 1952, p. xi-24-26.

15 Aileen Clawson, "The Bender Visual Motor Test as an Index of Emotional Disturbance", Journal Projective Techniques, Vol. 23, 1959, p. 198-206.

16 Eugene Byrd, op. cit., p. 132-135.

hypothesis that certain factors of the Bender test can be used to evaluate personality variables.

Although the purpose of Clawson's study was to give interpretive significance to the different factors that have been considered important in the reproduction of the Bender figures, her report was vague and at times failed to provide any interpretive hypothesis. This was especially true in the case of rotation, about which she stated:

When all figures with change of axis 15° were counted as "rotated", the sign became a significant differentiating factor. It would appear that the small rotations have greater diagnostic value but no hypothesis was formulated.¹⁷

Fabian¹⁸ worked with a group of emotionally disturbed children who were classified as retarded readers and non-readers and found them to have the tendency to rotate the horizontally oriented Bender designs to the vertical. In the same study, using 586 normal children ranging in age from five to nine years, he said:

The tendency to rotate horizontally directed configuration to the vertical position is found in the normal child of pre-school and beginning-school age. It is a developmental phenomenon which is gradually corrected as the child matures but does not disappear until he is seven or eight years of age.¹⁹

17 Aileen Clawson, op. cit., p. 205.

18 A. A. Fabian, "Vertical Rotation in Visual Motor Performance, Its Relation to Reading Reversals", Journal of Educational Psychology, Vol. 36, 1945, p. 129-154.

19 Id. Ibid., p. 151.

In an attempt to account for vertical rotation, Fabian stated:

Although verticalization is a developmental phenomenon, its persistence may be indicative of either mental deficiency or organic brain disease where it is a regressive feature. In the general school population, however, these abnormal conditions are relatively infrequent and, if present, they can be readily ascertained. Much more common are infantile patterns of behaviour due to emotional difficulties or environmental handicaps which inhibit the learning process and which betray themselves by primitive visual motor tendencies such as verticalization.²⁰

Koppitz²¹ in a study of children with learning disturbances, used a group of seventy-seven children in the age range of 8 years, 4 months, to 10 years, 8 months, to test and refine a scoring system and cross-validated her findings on a group of fifty-one children. The seven factors which she found significant were distortion of shape, rotation, substitution of circles or dashes for dots, perseveration, failure to integrate parts into wholes, three or more angles in the curve, and angles missing or extra. The cards that showed the most distortion were Figures a, 1, 3, and 7.

In relation to rotation and some of the other variables Koppitz concluded:

²⁰ Id. ibid., p. 152.

²¹ Elizabeth Koppitz, "The Bender-Gestalt Test and Learning Disturbances in Young Children", Journal of Clinical Psychology, Vol. 14, 1958, p. 292-295.

Since all of these deviations are found among young children as well as among psychotic patients, according to Pascal and Suttell, it is hypothesized that we are dealing here with phenomena of either immaturity and/or a loss of control due to confusion or regression.²²

Koppitz, like Fabian,²³ offered a very limited explanation to account for rotation, but did not elaborate the suggested possibility.

It can be observed from the above studies that rotation was the one variable which consistently appeared to differentiate the emotionally disturbed and schizophrenic child from the normal, but not the emotionally disturbed from the schizophrenic child.

3. Performance of Brain-damaged and Mentally Defective Children.

In comparing the performance of the Bender by thirty-three brain-injured mental defectives with that of thirty-three familial mental defectives, Bensberg²⁴ found that the latter group were significantly more accurate in Bender performance. The three variables of the Bender Test reproductions that he found significantly discriminating were

²² Id. Ibid., p. 295.

²³ A.A. Fabian, op. cit., p. 129-154.

²⁴ G.J. Bensberg, "Performance of Brain-injured and Familial Mental Defectives on the Bender Gestalt", Journal of Consulting Psychology, Vol. 16, 1952, p. 61-64.

rotations and reversals, repetition of parts and the use of lines instead of dots. Apart from mentioning the above characteristics there was no attempt to interpret the significance of these variables.

Baroff²⁵ reported a significant difference between brain-injured twins and non-brain-injured twins, in which the former had more perseverations, especially on design 1. In addition, they omitted a major part of at least one figure, most frequently number 7.

In a study of fifty-four exogenous and fifty-four endogenous subjects, Feldman²⁶ found the same variables as Baroff,²⁷ plus a failure of the exogenous group to overlap figures. He also found that twenty-eight of the endogenous and thirty-eight of the exogenous subjects produced rotations on all designs, but there was no reliable discrimination between the two groups in this regard.

In a study that dealt directly with rotation, Hanvik had observed and stated:²⁸

²⁵ George S. Baroff, "Bender Visual-Motor Function in Mental Deficiency", American Journal of Mental Deficiency, Vol. 61, 1957, p. 753-758.

²⁶ Irving S. Feldman, "Psychological Differences Among Moron and Borderline Mental Defectives", American Journal of Mental Deficiency, Vol. 57, 1953, p. 484-494.

²⁷ George Baroff, op. cit., p. 758.

²⁸ Leo J. Hanvik, "Note on Rotation in Bender-Gestalt Test", Journal of Clinical Psychology, Vol. 9, 1953, p. 399.

It has been our opinion for some time that the rotation of the Bender figures is an even more malignant sign when it occurs in children than when it occurs in adults and that rotation is a visual-motor aberration almost pathognomic for brain damage in children.²⁹

Havvik found the electroencephalogram to be a good check for brain damage, since he obtained a high correlation between rotations of the Bender figures and electroencephalographic abnormalities. In a group of twenty children who produced one or more rotations on the Bender, an abnormal electroencephalogram numbered eighty per cent.

Halpin,³⁰ in a similar study using fifteen brain-injured and fifteen non-brain injured defective children, found no significant difference in the number of rotations between the two groups. Since rotation was found in both groups, failure to obtain significance was possibly caused by the overlap between the groups. A further explanation might be found in the operational definition of rotation:

A "rotation" error was defined as a 90° turning of the entire figure on its horizontal vertical axis with the relationship between the parts maintained.³¹

29 Id. Ibid., p. 399.

30 Virginia G. Halpin, "Rotational Errors on BG", American Journal of Mental Deficiency, Vol. 59, 1955, p. 484-489.

31 Id. Ibid., p. 486.

As Clawson³² pointed out earlier, it might possibly make a difference if rotation had been measured by the number of degrees from the original axis, thus taking into account the smaller rotations.

It has been seen that during the performance of the Bender-Gestalt many children have drawn or reproduced the design correctly but in a rotated position.

Rotation has been found to occur more significantly in pathological groups than in normal groups, yet few studies have attempted to determine the reasons for this distortion in reproduction. However, one study had suggested its relationship in brain-injured children to a lesion, most likely in the basal ganglia,³³ while in children with learning problems it was ascribed to the regressive phenomenon.^{34, 35.}

Since there have been so few attempts in the past to account for the appearance of rotation, further investigation is needed. The next chapter will attempt to provide a tentative rationale for rotation on the Bender-Gestalt cards in terms of the influence of stimulus variation, cue

32 Aileen Clawson, op. cit., p. 205.

33 Leo Hanvik, op. cit., p. 399.

34 A. V. Fabian, op. cit., p. 153-154.

35 Elizabeth Koppitz, op. cit., p. 295.

utilization or a combination of the two.

CHAPTER II

THEORETICAL CONSIDERATIONS OF ROTATION

1. Stimulus Variation.

Boring in a recent article stated:

The effective stimulus is not an object but a property of the stimulus-object, some crucial property that cannot be altered without changing the response, some property that remains invariant, for a given response, in the face of transformation of other characteristics.¹

It would seem that stimulus-objects, in this paper the Bender Cards and their designs, have a number of properties. These properties of the stimulus-object may be of greater or lesser importance in producing a response. Can the role of certain stimulus properties be observed by varying certain aspects of the stimulus situation? This paper will consider certain stimulus variations of the Bender Test in terms of variation of figure, ground, and configurations together with their influence, if any, upon rotation.

A. Figure Variation.

The word figure applies to the design which the subject has to reproduce, and will be considered in terms of a horizontal-vertical orientation to the background. The

¹ Edwin G. Boring, "Visual Perceptions as Invariance", Psychological Review, Vol. 59, No. 2, 1952, p. 141-148.

five original Bender figures used in this study were all in a horizontal relationship to the background. That is, both figure and background were orientated in the same direction.

Goldstein and Scheerer,² in an experiment using the Kohs Blocks, found that the vertical position appeared stronger to the subject than the position on a horizontal base; this produced a greater amount of rotation in the reproduction of the blocks. They concluded:

... position on a horizontal base of such figure is more natural, more concrete if preferred configuration is changed or interfered with performance is made more difficult.³

Shapiro⁴ in a study using the Kohs Blocks stated:

... when figure is parallel to the axis of the background the anomaly would be minimized, and when figure is at an angle maximized.⁵

An "anomaly" for Shapiro existed when a pattern had been correctly produced, but rotated by 45° ; very seldom was the pattern found to be rotated to a greater extent than 45° .

2 K. Goldstein and M. Scheerer, "Abstract and Concrete Behaviour: An Experimental Study with Special Tests", Psychological Monogram, Vol. 53, 1941, p. 32-57.

3 Id. Ibid., p. 40.

4 M.B. Shapiro, "Experimental Studies of a Perceptual Anomaly. II. Confirmatory and Explanatory", Journal of Mental Science, Vol. 98, 1952, p. 605-617.

5 Id. Ibid., p. 616.

Using the same test, Yates⁶ had his subjects draw both the figure and ground designs. He found the figure exerted the main influence when it was in a vertical position rather than a horizontal one.

Williams,⁷ using the Block Design Test, found there was a significant interaction between figure and ground. However, rotation was increased when figure and ground were incongruent.

A further study by Bakay and Schiller⁸ showed normal subjects, when asked to turn a figure into any position, almost always placed the figure with the lines of symmetry parallel to either the vertical or horizontal axis of the visual field.

These studies seem to indicate that orientation of a figure does affect the subject's performance. Hence, the properties of a figure, in relation to horizontal and vertical orientation, should be explored to see what effect there is upon the rotation factor. It can now be postulated that

6 Aubrey J. Yates, "Rotation of Drawings by Brain-Damaged Patients", Journal of Abnormal and Social Psychology, Vol. 53, 1958, p. 178-181.

7 Harold L. Williams, et. al., "The Relation of Brain Injury and Visual Perception to Block Design Rotation", Journal of Consulting Psychology, Vol. 20, 1956, p. 275-280.

8 E. Bakay and P. H. Schiller, "Manipulative Correction of Visually Presented Figures", American Journal of Psychology, Vol. 61, 1948, p. 487-502.

rotation may occur more frequently on the Bender Cards when the figure is in a vertical position rather than in a horizontal one.

The foregoing section has considered an aspect in the variation of figure. These variations will be treated in different groups of cards with the same five designs in each group. However, for convenience these variations will henceforth be designated by use of the term sets.

B. Ground Variation.

The original Bender figures were placed on rectangular cards. This section will be concerned with ground orientation as influenced either by a rectangular or diamond shaped card.

The ground, defined as the white card on which the design is placed, has been shown to affect the amount of rotation. Goldstein and Scheerer⁹ found in the use of their cube test that a diamond orientation of a cube tended to increase the frequency of rotation, while the square orientation tended to diminish it. They considered the diamond to have "worse form" than the square. The latter was the preferred configuration since simplicity and balance tended to lessen rotation. Their work has been corroborated by

⁹ Goldstein and Scheerer, op. cit., p. 39-42.

Shapiro,¹⁰ Yates,¹¹ and Williams¹² who found the Koh Blocks with a diamond-orientated ground produced more rotation than a square-orientated ground.

To conclude, Koffka¹³ reported that Hartmann found the critical fusion rate for a flickered square point increased when it was turned into the diamond position.

The above studies give some indication that the properties of a diamond figure are not as substantial as those of a square figure. More rotation seems to occur when an object is in a diamond shape than in a square.

Can it be assumed that the properties of the Bender Cards, presented in a rectangular shape, would produce the same, more, or less rotation than when presented in a diamond shape?

The quantitative results of Nelson¹⁴ concerning criteria for different types of form indicated different criteria favoured different forms. The criteria he used can be summarized as follows: the form requiring the least amount of light; the form that was confused the least number

10 M. B. Shapiro, op. cit., p. 615-616.

11 Aubrey J. Yates, op. cit., p. 179-180.

12 Harold Williams, et al., op. cit. p. 274-275.

13 K. Koffka, Principles of Gestalt Psychology, London, Kegan Paul, 1935, xii-270 p.

14 Harry Nelson and E.V. Fehrer, "The Role of Form in Perception", American Journal of Psychology, Vol. 44, 1932, p. 79-102.

of times with other forms; the form that required the least amount of re-exposures; and the form seen first the greatest number of times. The figures used were the triangle, angle, square, circle, rectangle, and diamond. Nelson concluded:

If we were to choose the best form on the basis of all our criteria taken together, the rectangle would get first place.¹⁵

Following the rectangle in order of best form was the square and circle with the diamond at the opposite extreme.

Casperson,¹⁶ obtained discriminative data for thirty geometric figures which consisted of five variations in the use of six basic forms. His subjects were required to make visual judgments of these forms. The basic forms employed were the triangle, ellipse, diamond, rectangle, cross and star. In terms of relative discriminability of forms using area, maximum dimension, variation of perimeters and total per cent of correct reports for each form, the following order was found: triangle, rectangle, cross, circle, diamond, and star. In terms of total responses made for each form shown, the following order was found: circle

15 Id. Ibid., p. 102.

16 Roland Casperson, "The Visual Discrimination of Geometric Forms", Journal of Experimental Psychology, Vol. 40, 1950, p. 668-682.

rectangle, triangle, diamond, and cross.

In the above studies, evidence first showed that a diamond-shaped ground tended to produce more rotation than a square-shaped ground. Secondly, it was shown that in relation to a diamond-shaped object a rectangular shape was, in terms of form, as "good" and as "simple" in structure as a square.

Therefore, it might be postulated that rotation will occur more often on the Bender Cards when the background is in the shape of a diamond than when it is in the shape of a rectangle.

The foregoing section has considered certain aspects in variation of the ground. These variations, as in the section entitled "Figure Variation", will also be designated by the term sets.

The next section will deal with the five designs, which will in the future be called configurations.

C. Configurations.

The configurations used in this experiment were designs a, 1, 2, 3, and 8 of the original Bender designs.¹⁷ The choice of these five configurations will be discussed later. In consideration of each individual configuration it has been pointed out that they are not equivalent items and

¹⁷ Laretta Bender, op. cit., p. 4.

that different configurations will elicit different responses. Bender's¹⁸ findings, as stated in her chart, showed that only twenty-five per cent of the adults were able to copy figure 1 correctly. The important factor here was the pairing of dots, which were based upon recognition of a Gestalt principle. Each of the configurations was based upon a particular Gestalt principle, which gave it a distinction of its own. The chart further showed that different configurations were mastered at different ages, i.e., Figures a, 1, 4, and 5 at six years of age and Figures 6 and 8 at eight years.

Koppitz¹⁹ found when the configurations were analyzed separately in regard to distortion, that distortion occurred less frequently in 1, 4, 6, and 8 and more frequently in Figures a, 2, 3, 5, and 7. In a study by McPherson²⁰ configurations a, 1, 2, 3, and 5 were the ones that showed the most distortion.

Other studies^{21,22,23} have shown that different responses were obtained from different configurations depending

18 Id. Ibid., p. 132-133.

19 E. M. Koppitz, *op. cit.*, p. 295.

20 Marian White McPherson and Loretta A. Pepin, "Consistency of Reproductions of Bender-Gestalt Designs", Journal of Clinical Psychology, Vol. 11, 1955, p. 163-166.

21 Eugene Byrd, op. cit., p. 128-131.

22 George S. Bareff, op. cit., p. 756-758.

23 Franklin H. Goldberg, op. cit., p. 533-534.

upon the kind of group used and the type of symptom studied.

It can be assumed from the above studies that the Hender configurations are not equivalent items. Therefore, it can be postulated that some of the configurations produce more rotation than others.

2. Cue Utilization.

In 1947, Cameron²⁴ made the assumption that emotions reduce cerebral competence. He considered cerebral competence as being able to use all the cues or information necessary at any one time for an appropriate response. The use of cues or, as designated in this study, the range of cue utilization, was described in general by Easterbrook as:

The total number of environmental cues in any situation that an organism observes, maintains an orientation towards, responds to, or associates with a response.²⁵

Cue utilization was considered equivalent to the amount of information in use by a person at any one time. The information used under certain circumstances is related to the number of cues employed. Therefore, the more difficult the task, the greater amount of information or number of cues

²⁴ N. Cameron, The Psychology of Behaviour Disorders, New York, McGraw-Hill, 1947, p. 540-575.

²⁵ J.A. Easterbrook, "The Effect of Emotion on Cue Utilization and the organization of Behaviour", Psychological Review, Vol. 66, 1959, p. 183.

needed.^{26,27}

It has been shown that the range of cue utilization may be thought of as "total information used".^{28,29,30} This implies that the range of cue utilization can be regarded as an index of cerebral competence.

Two other studies^{31,32} in comparative psychology have advanced a hypothesis to this effect. Further support has

26 P. L. Brodthuret, "The Interaction of Task Difficulty and Maturation: The Yerkes-Dodson Law Revived", Acta Psychologica, Vol. 16, 1959, p. 321-335.

27 H. P. Bahrick, "Incidental Learning under Two Incentive Conditions", Journal of Experimental Psychology, Vol. 47, 1954, p. 170-172.

28 G.A. Miller, "The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information", Psychological Review, Vol. 63, 1956, p. 81-97.

29 K. E. Hick, "On the Rate of Gain Information", Quarterly Journal of Experimental Psychology, Vol. 4, 1952, p. 11-26.

30 M. A. Born and H. Rubenstein, "Information Theory and Immediate Recall", Journal of Experimental Psychology, Vol. 44, 1952, p. 260-266.

31 D. O. Hebb and W. A. Thompson, "The Social Significance of Animal Studies", in G. Lindzey (ed.), Handbook of Social Psychology, Cambridge, Mass., Addison-Wesley, 1954, p. 532-561.

32 H. W. Nissen, "Phylogenetic Comparison", in S. S. Stevens (ed.), Handbook of Experimental Psychology, New York, Wiley, 1951, p. 347-386.

been given by Birren³³ and Griew³⁴ in that the range of cue utilization appears to be reduced by ageing of the subject.

Brain-injured subjects sometimes make errors of orientation in the reproduction of a figure and Beech³⁵ has shown this occurrence to be negatively related to intelligence. This study also seems to support the proposition that range of cue utilization is an index of cerebral competence.

It is then felt that an individual is competent when he is able to use all the cues or information available at any one time for an appropriate response.

That emotion tends to reduce this range of cue utilization is reported by Easterbrook³⁶ and Duffy.³⁷ They have shown that emotion is aroused to a greater extent and general excitement is increased more in neurotics than in normals. It is also greater in subjects under stress, threat, or frustration.

33 J. E. Birren, "A Factorial Analysis of the Wechsler-Bellevue Scale Given to an Elderly Population", Journal of Consulting Psychology, Vol. 16, 1952, p. 399-405.

34 S. Griew, "Age Changes and Information Loss in Performance of a Pursuit Tracking Task Involving Interrupted Preview", Journal of Experimental Psychology, Vol. 55, 1958, p. 486-489.

35 H. R. Beech, "An Investigation of the Performance on a Perceptual-Motor Task by Psychotic Patients with Special Reference to Brain-Damage", Unpublished Ph.D. Thesis, University of London Library, 1956, 148 p.

36 J. A. Easterbrook, op. cit., p. 183-201.

37 E. Duffy, Leeper's "Motivational Theory of Emotion", Psychological Review, Vol. 55, 1948, p. 324-328.

Callaway and co-workers³⁸ have hypothesized that the attentive field tends to become narrower in emotionally disturbed subjects and that the perceptive field also tends to be reduced.

Eysenck and Granger³⁹ showed that neurotic and psychotic patients were slower in three dimensional perception, made lower acuity scores and lower scores in recognizing briefly exposed letters. This again showed reduced usage of the cues presented.

It has been suggested that the reduction under stress in the range of cue utilization represents a decrease in the perceptive field.^{40,41}

Jenkins⁴² showed that when there is some degree of ambiguity or equivalence in a perceived object, there is a

38 E. Callaway and E. Dembe, "Narrowed Attention: A Psychological Phenomenon that Accompanies a Certain Physiological Change", Archives Neurology and Psychiatry, Vol. 79, 1956, p. 74-90.

39 H. J. Eysenck and G. W. Granger, Perceptual Process and Mental Illness, London, Chapman and Hall, 1957, p. 239.

40 A. E. Bussill, "The Restriction of Peripheral Visions During Exposure to Hot and Humid Conditions", Quarterly Journal of Experimental Psychology, Vol. 10, 1958, p. 113-129.

41 A. W. Combs and C. Taylor, "The Effect of the Perception of Mild Degree of Threat on Performance", Journal of Abnormal and Social Psychology, Vol. 47, 1952, p. 420-424.

42 N. Jenkins, "Affective Processes in Perception", Psychological Bulletin, Vol. 54, 1957, p. 100-127.

narrowing of attention, the emotional component being contributed to the evaluative response of the subject.

Schilder and Goldstein have stated:

There is a notable tendency in persons with a profound degree of mental confusion to react to very limited aspects of the perceptual field and have a visual incapacity to relate perceived objects to their wider settings.⁴³

Yates⁴⁴ showed that subjects are able to counteract rotation producing stimuli, provided the usual visual indications of "verticality" and "horizontalness" are available. However, when these indications were artificially removed many normal subjects began to rotate to a considerable extent, since they were then more dependent on the rotation-inducing cues.

In a related study, Shapiro⁴⁵ found that normal subjects would rotate as much on block design as

43 P. Schilder and Kurt Goldstein, "Recovery of Optical Orientation in the Post Traumatic Confusional State", Brain, Vol. 67, 1944, p. 57.

44 A. J. Yates, "Experimental Studies of a Perceptual Anomaly. IV. The Effect of Monocular Vision on Rotation", Journal of Mental Science, Vol. 100, 1954, p. 975-979.

45 M. B. Shapiro, "Experimental Studies of a Perceptual Anomaly. III. The Testing of an Explanatory Theory", Journal of Mental Science, Vol. 99, 1953, p. 394-409.

brain-damaged subjects when deprived of most of their visual directional cues.

In another study, Yates⁴⁶ investigating the influence of a number of factors on the induction of the rotation effect in normal subjects found the presence or absence of visual directional cues immediately surrounding the stimulus figure to be the most significant.

In a study on space orientation, Witkin and Asch⁴⁷ found that the directional qualities perceived by subjects are a function of the organization of stimulation available to the subjects at that time. It was further indicated that many of the subjects' perceptions of a field were functions of the visual, directional cues available.

In another study by Asch and Witkin⁴⁸ it was demonstrated that errors in the perception of the vertical field varied, according to the amount of information derived from the surroundings.

46 A. J. Yates, "Experimental Studies of a Perceptual Anomaly. V. Some Factors Influencing the Appearance of the Block Design Rotation Effect in Normal Subjects", Journal of Mental Science, Vol. 102, 1950, p. 761-771.

47 H. A. Witkin and S. E. Asch, "Studies in Space Orientation. III. Perception of the Upright in the Absence of a Visual Field", Journal of Experimental Psychology, Vol. 38, 1948, p. 603-614.

48 S. E. Asch and H. A. Witkin, "Studies in Space Orientation. II. Perception of the Upright with Displaced Visual Fields", Journal of Experimental Psychology, Vol. 38, 1948, p. 325-337.

It follows from the foregoing studies that emotions tend to reduce the range of cue utilization and that the range of cue utilization can be regarded as an index of cerebral competence. Further, it is felt that rotation may be influenced by a lack of cue utilization due to emotional excitation, arousal or disturbance.

Emotional excitation, arousal or disturbance, hence range of cue utilization was considered in terms of three different groups of individuals according to severity of disturbance. Thus, for convenience sake, range of cue utilization will be designated in the term groups.

From the aforementioned rationale and considerations the following general hypothesis can be set forth. Rotation will be influenced differently by the six sets depending upon the figure-ground orientation. The five configurations will influence rotation in different ways because they are not equivalent items and the three groups will influence rotation differently in terms of the availability of range of cue utilization.

For the sake of experimental verification the general hypothesis will be broken down into the following sub-hypothesis:

1. There is no significant difference between the amount of rotation produced by any two of the six sets of cards.
2. There is no significant difference between the amount of rotation produced by any two of the five configurations.

3. There is no significant difference between the amount of rotation produced by any two of the three groups.
4. There is no significant interaction between the six sets and the five configurations in the amount of rotation produced.
5. There is no significant interaction between the six sets and the three groups in the amount of rotation produced.
6. There is no significant interaction between the three groups and the five configurations in the amount of rotation produced.
7. There is no significant interaction among the six sets, five configurations and the three groups in the amount of rotation produced.

The next chapter will give a description of the procedures for the experimental design.

CHAPTER III

DESIGN OF THE STUDY

The hypotheses set up in the previous chapter are the basis of the design of this study. The investigator has devoted this chapter to the sample, the instrument, and the statistical approach.

1. Sample.

For testing the hypothesis of this study, three sample groups were selected. These were normal, disturbed and schizophrenic subjects between eight and fifteen years of age. The upper age limit was determined by its consideration as the critical age with regard to diagnosis and treatment of patients considered children rather than adults. The lower age level was selected because it has been shown by Fabian¹ that rotation is expected in normal children up to the age of seven and that it is a "developmental phenomenon which is gradually corrected".

Similarly, Bender² has shown that relatively little change occurs in the gestalt figures between one child and another in the ages over seven. Koppitz³ has also shown

1 A. v. Fabian, op. cit., p. 152.

2 Lauretta Bender, op. cit., p. 133.

3 Elizabeth Munsterberg Koppitz, op. cit., p. 294-295.

that children under eight cannot reproduce the Bender figures adequately.

The normal subjects were children of average or above average intelligence who had never been referred for psychiatric help nor considered behaviour problems by school authorities, teachers, or the school psychologist.

The school psychologist had, as a routine procedure, administered a group intelligence test to the children.⁴ She also tested for laterality patterns using the Harris tests of Lateral Dominance.⁵

When the school psychologist was satisfied that the child was of at least normal intelligence and had neither personality problem, evidence of mixed dominance, nor poor perception of orientation in space, the child was included in the study. A total of ninety individuals were used in this study as a normal sample.

The second group consisted of ninety children who were not schizophrenic, mentally defective nor known to have brain lesions at the time of testing. A variety of symptoms were present, all of which can best be described clinically

⁴ Thelma Gwinn Thurstone and L. L. Thurstone, S R A Primary Mental Abilities for Ages 7 to 11, Chicago, Science Research Associates, 1948, Revised 1954.

⁵ Albert J. Harris, The Harris Test of Lateral Dominance, New York, The Psychological Corporation, 1947.

as maladjusted behaviour associated with emotional disturbances. They were selected at random from various child guidance clinics. There was staff agreement in relation to the above criteria which was based on case-history diagnostics and symptomatology of the patient.

All children at the time of testing had been referred to a clinic for psychological assistance. The records were checked to make sure there was no gross visual field defect present.

Schizophrenic children made up the last group. They were diagnosed as such by the psychological staffs in the hospitals in which they were found. All children were excluded who were known to have detectable brain-damage, mental deficiency or an obvious physical handicap. A double check of the diagnosis was made in a majority of the cases. An outpatients clinic had originally diagnosed as schizophrenic most of these children and referred them to other facilities. With the list of children available from the outpatient clinic, it was possible to recheck the diagnosis through the institution in which they were presently receiving care. The sample was made up of ninety children.

With an age range of eight to fifteen for the three groups, the mean age of the normal children was 11.54, the emotionally disturbed children, 11.24, and the schizophrenic children, 11.70.

No criteria with regard to the sex of the subject or to intelligence were set up. Yates,⁶ Peeks,⁷ and Pascal and Suttell⁸ found no relationship between the reproduction of a design and the intelligence or sex of the subject. In another study by Beech⁹ in which brain-damaged, disturbed, and normal subjects were used, drawn reproductions of figures were found to be negatively related to intelligence.

2. Instrument.

Description of the Test.- The test consists essentially of thirty white cards, fifteen cards four by six inches and fifteen cards five by five inches in size. On each of these cards one of the five Bender configurations is printed.

⁶ Aubrey Yates, "The Rotation of Drawings by Brain-damaged Patients", Journal of Abnormal and Social Psychology, Vol. 53, 1956, p. 171-181.

⁷ R. M. Peeks and G. W. Olson, "The Bender-Gestalt Recall as an Index of Intellectual Functioning", Journal of Clinical Psychology, Vol. 11, 1955, p. 185-188.

⁸ Gerald R. Pascal and Barbara J. Suttell, The Bender Gestalt Test, Grune and Stratton, New York, 1951, p. 41-62.

⁹ H. R. Beech, "An Investigation of the Performance on a Perceptual-Motor Task by Psychiatric Patients with Special Reference to Brain-damage", Unpublished Ph.D. Thesis, University of London Library, 1956, 148 p.

The principal variables involved in a description of the test are as follows:

1. The white cards on which the configurations were printed were referred to as the ground shape and were presented in two orientations, one in which the ground shape appeared as a rectangle and one in which it appeared as a diamond.
2. The orientation in which the configurations were presented were referred to as the figure shape. They were presented in two positions, one vertical and the other horizontal.
3. The designs of the figure shapes were referred to as the configurations. The five configurations which are included in the test are shown in figure 1.
4. The configurations chosen for this study were selected because they have been found to produce more rotation than the other Bender figures.10,11,12

The configurations themselves were numbered one to five. The thirty cards of the test consisted, therefore, of six sets of five, each set containing one each of the five configurations. These six sets were lettered a, b, c, d, e, and f and were arranged in the following manner:

1. The first set consisted of the original Bender configurations and cards, the ground being rectangular and the configurations horizontal.
2. In the second set all configurations were rotated ninety degrees counter-clockwise to produce the vertical effect. The ground shape remained rectangular.

10 Marien White McPherson and Laretta A. Pepin, "Consistency of Reproduction of Bender-Gestalt Designs", Journal of Clinical Psychology, Vol.11, 1955, p. 163-166.

11 Elizabeth M. Koppitz, op. cit., p. 295.

12 Franklin H. Goldberg, op. cit., p. 552.

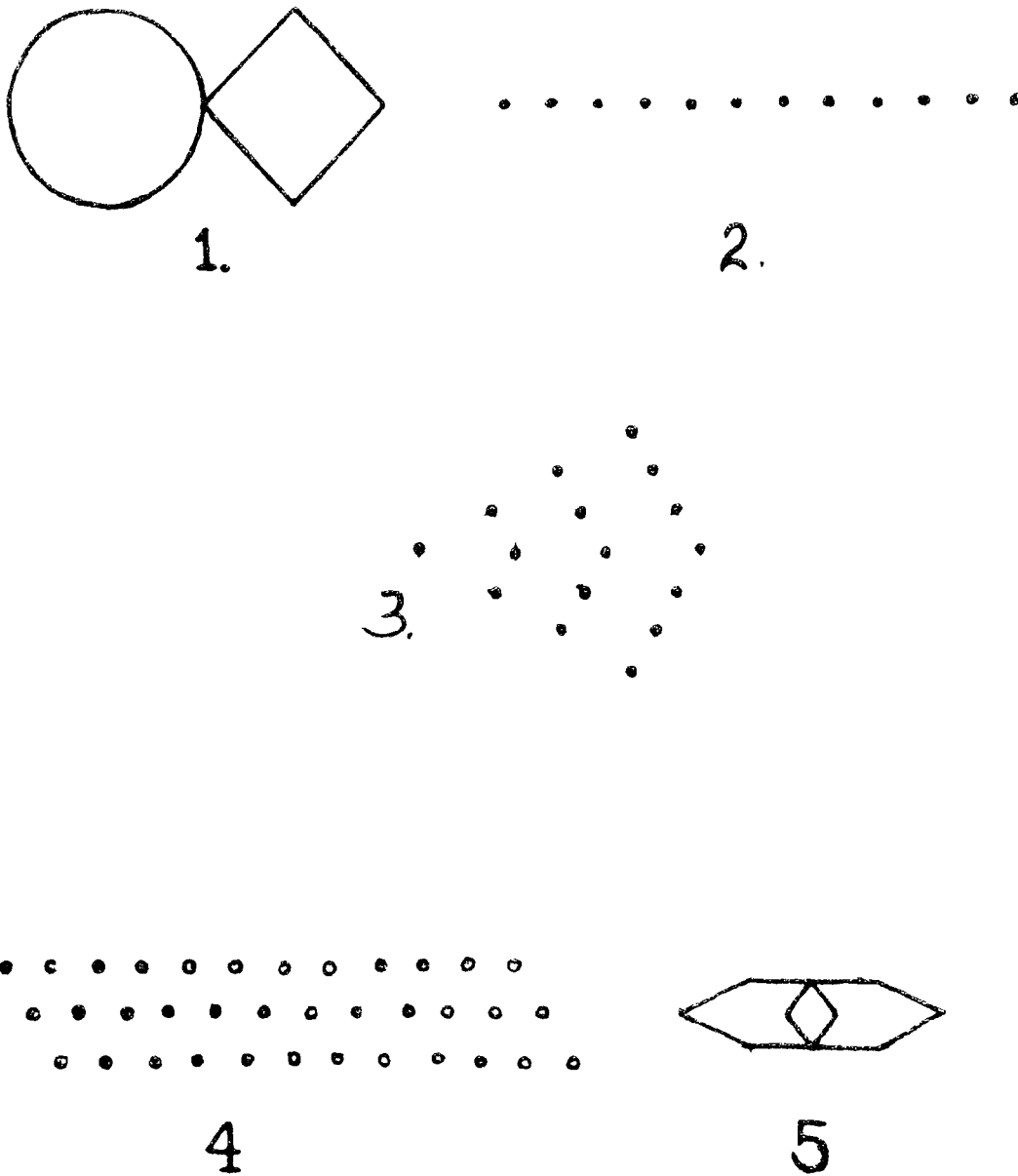


Figure 1 An illustration of the five configurations to be used in this study.

3. The ground shape in the third set was in the form of a diamond with the configuration horizontal.
4. The fourth set was a combination of sets two and three. The ground was in the form of a diamond and the configuration in a vertical position.
5. In the fifth set the rectangular card was rotated ninety degrees counter-clockwise to give a vertical ground effect, with the configurations remaining in a horizontal position.
6. The last set was a combination of sets two and five. The configurations were rotated ninety degrees counter-clockwise so that they would be in a vertical position and the rectangular card was rotated ninety degrees so that it would be in a vertical position.

The relationships obtained may be seen more clearly by reference to figure 2, which presents a concrete illustration of each type of combination.

The reason for rotating some of the cards and figures ninety degrees counter-clockwise was an arbitrary choice on the part of the writer. They could have been just as easily rotated ninety degrees clockwise. This technique was only used to assure uniformity through the sets.

Administration of the Test.- The subject was seated before a table and the card with the configuration on it placed so that the edge of the stimulus card was about an inch above and in the middle of the top edge of the drawing paper.

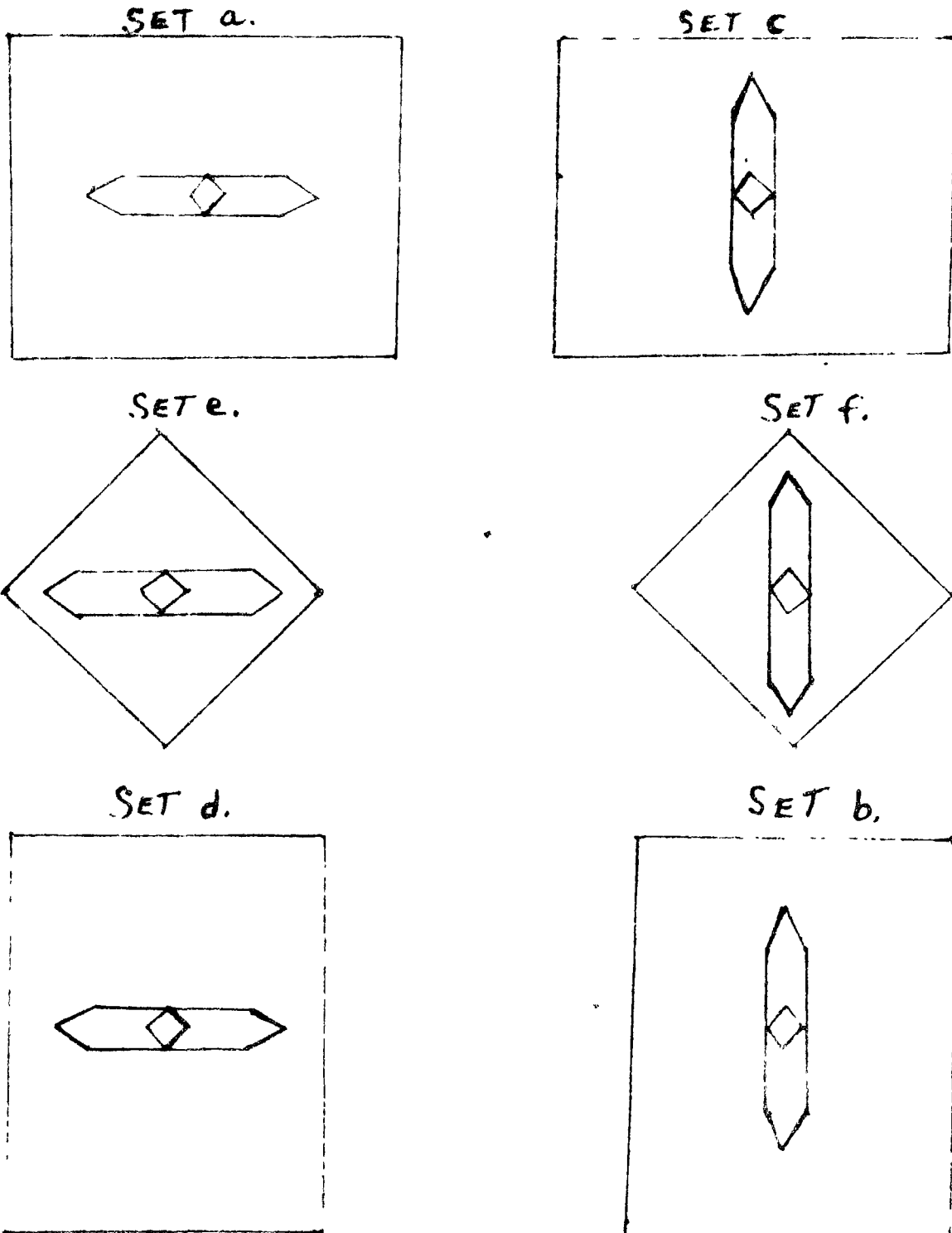


Figure 2 An example of the different combinations of figure and ground for the six sets to be used in this study.

The test was individually administered within the three groups with the following directions given by the examiner:

"I am going to show you three cards, one at a time. Each card contains a figure. I want you to copy these figures on the paper as well as you can."

The drawings were limited to one side of an 8½ by 11 inch sheet of white paper and to one drawing per piece of paper. There was no time limit and a child was free to erase or change any configuration in his own way. He was not allowed to turn the stimulus card or the paper upon which the configuration was to be given. The paper was placed in the usual vertical position.

Individuals had to draw three configurations with only the last configuration being scored for degree of rotation. The first two cards were in addition to the thirty cards used in this experiment. They served as buffer cards or practise cards and were given to all subjects.

Since each subject would only be requested to draw one configuration it was felt that they should have the opportunity to warm up or get accustomed to this type of testing situation. These two practise cards consisted of two very simple configurations, one a triangle and the other a square. There was no special reason for choosing these two particular configurations except that they are considered

to be relatively easy to reproduce. Individuals within a group were assigned at random to each of the thirty cards.

Scoring and Measurement.- Rotation was considered as any reproduction of a drawing which altered the actual axis of the drawing. This could only be produced in one way; the subject rotated the configuration while copying it from a properly oriented stimulus card onto an equally oriented piece of paper.

This is to be distinguished from cases in which the subject produces rotation due to a shift in the position of the paper while drawing the configuration, and from cases in which the subject rotates the stimulus card and then reproduces the configuration accurately in that position. The definition of rotation in this study is generally followed by the authors whose studies were reviewed in the chapter entitled Review of the Literature.

It is also apparent to the present writer that there is no reason to assume that the same mechanisms are operating in the above three ways of rotating, therefore, all three of them cannot be used under a single definition of rotation. Since the one to be considered in this study is the one applied by most authors, it will be used.

The scoring system with respect to accuracy was very lenient. A failure was recorded only if the reproduction was clearly unrecognizable, i.e., if it contained a configuration

which was completely different to that of the original or was left incomplete.

The measurement of the number of degrees of rotation from the original axis was made with a protractor and ruler in the following way:

1. For sets a, b, and e a first line was drawn parallel to the longside of the drawing paper just touching the configuration. A second line was drawn perpendicular to the first line at the point of intersection of the configuration and the first line. A third line was drawn from the above point of intersection to a point on the main axis of the configuration.
2. For sets c, d, and f the first line was drawn parallel to the base of the drawing paper just touching the configuration. The second and third lines were drawn in the same manner as the above sets.

Before measuring the amount of rotation it was necessary to establish the point on the main axis of the configuration through which the third line would be drawn. The following method was employed:

1. For configuration 1 the third line was drawn from the point of intersection of lines at the base of the circle. If there was no rotation the second and third lines would coincide and divide configuration 1 into symmetrical and equal parts.
2. In configuration 2 the third line was drawn on the right side of the first dot so that it was barely touching the dot. For some of the configurations there was the problem of curvilineariry. This was met by drawing the line next to the place where most of the dots would fall in a straight line.

3. For configuration 3 the third line was also drawn on the right side of the first dot so that it was barely touching the dot. If this configuration was not rotated the second and third lines would coincide and divide it into symmetrical and equal parts.
4. The third line was drawn to the right of the three bottom dots of configuration 4, just barely touching the dots. Curvilinearity was handled in the same manner as in configuration 2.
5. For configuration 5 the third line was drawn from the midpoint of the end of the configuration. If there was no rotation, lines two and three would coincide and divide the configuration equally.

The score recorded for an individual was the total number of degrees line three deviated from line two. An example of the scoring system is shown in figure 3.

3. Statistical Analysis.

The general statistical approach used in this study is that of a triple classification factorial design, employing analysis of variance. The three variables used in the present experiment were sets, configurations, and groups.

The model used was the ABC type¹³ in which only systematic variation is taken into consideration.

The residual mean square within groups was chosen as the error term for this type of model since it is generally considered the appropriate term to use.

¹³ Lawrence T. Dayhaw, Manuel de Statistique, Editions de l'Universite d'Ottawa, Ottawa, Canada, 1958, p. 460.

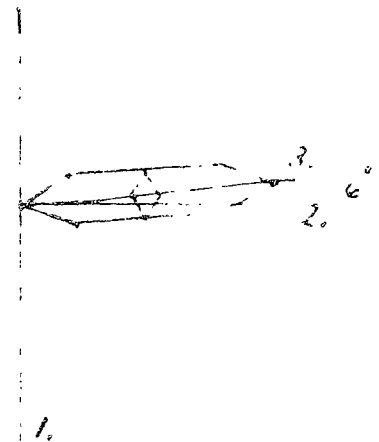
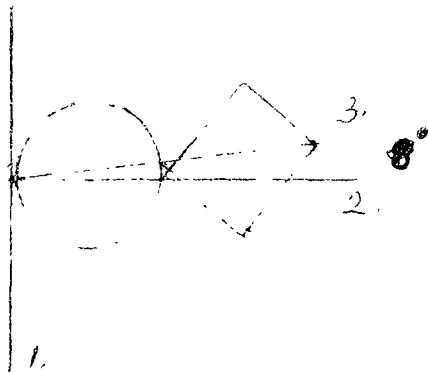
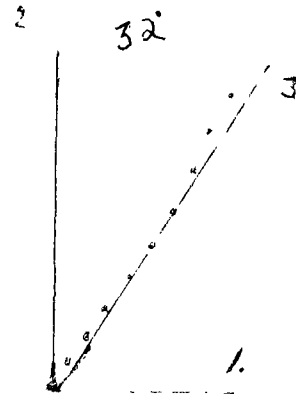
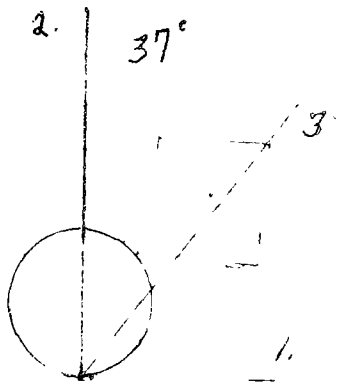


Figure 3 An illustration of the scoring system for measuring rotation.

A level of significance of p equals .01 was the criterion chosen to reject the possibility that a result might have occurred by chance. McNemar¹⁴ suggests that a level more stringent than p equals .05 seems required to eliminate false rejection of a null hypothesis.

Since analysis of variance is an overall test of significance, if the hypothesis is found to be false, the results should be further analyzed by means of 't' tests to determine which variables were the significant ones.

The next chapter will present the results of the experiment carried out according to the above procedures.

¹⁴ Quinn McNemar, Psychological Statistics, John Wiley & Sons, Inc., New York, 1949, p. 68.

CHAPTER IV

THE RESULTS OF THE EXPERIMENT

The results will be considered in relation to the hypotheses which were formulated at the end of the third chapter. The hypotheses will be discussed in the order in which they were set up. The summary of the analysis of variance is presented in Table I.

1. Analysis of Data for Main Effect: Sets.

The rotation scores for the main effect, sets, as seen in Table I is significant beyond the .001 per cent level of confidence when tested against the residual variance. Therefore the null hypothesis would have to be rejected since the six sets differ significantly.

With the F for sets significant, t -tests were used to determine the significance between the means of the sets. Results of the t -test on differences in the means of rotation for sets are given in Table II. The formula used for the t -tests was Significant Difference $\geq t (p = .01) \times \sigma_{DIFF}$.

The formula used for the σ_{DIFF} was $\sigma_D = \sqrt{\frac{2\sigma^2}{n_s}}$

The residual variance served as the error term for the σ^2 of the above formula. The value $t (p = .01)$ was read

Table I.-
Summary of Analysis of Variance of the
6 x 5 x 5 Factorial Design.

Source of Variation	SS	df	Estimate of Variance	F	F.01	F.001
G (Groups)	23434.33(6)		11742.16	20.88	4.60	6.91
S (Sets)	9131.52(5)		1826.30	4.63	3.02	4.10
C (Configuration)	6127.26(4)		1531.82	3.63	3.32	4.62
G x S	20659.77(10)		2065.97	4.24	2.34	3.01
G x C	6304.38(8)		788.04	1.96	2.51	3.27
S x C	24318.24(20)		1215.91	3.82	2.01	2.54
G x S x C	14260.63(40)		356.51			
Intra	70929.67(180)		394.05			

Table II.-

Evaluation of the Difference of Means on the Rotation Scores
of the Six Sets by Means of the t-Test.

Sets Used	Mean Values Compared	Difference	Significant Difference
a-b	3.20- 4.30	1.10	No
a-c	3.20-14.20	11.00	Yes
a-d	3.20-17.30	14.10	Yes
a-e	3.20-23.40	20.20	Yes
a-f	3.20-20.60	17.40	Yes
b-c	4.30-14.20	9.90	No
b-d	4.30-17.30	13.00	Yes
b-e	4.30-23.40	19.10	Yes
b-f	4.30-20.60	16.30	Yes
c-d	14.20-17.30	3.10	No
c-e	14.20-23.40	9.20	No
c-f	17.30-20.60	6.40	No
d-e	17.30-23.40	6.10	No
d-f	17.30-20.60	2.30	No
e-f	23.40-20.60	2.80	No

from the table of t values for a number of degrees of freedom equal to that of the error term. In this case for 180 df, t was equal to 2.604. Thus the significant difference $\geq 2.604 \times 4.18$ or 10.87. It will be noted from Table II that set a is significantly different from sets c, d, e, and f, and that set b is significantly different from sets d, e, and f. This means that sets a and b produced very little rotation and when compared to sets c, d, e, and f, which produced a great deal of rotation, the means were significantly different. In fact, it would make little difference which of the last four sets was used in this study since each seems to contribute about the same amount of rotation. This is why the differences between any of the other combinations were not significant.

2. Analysis of Data for Main Effect: Configurations.

It can be seen in Table I that the F test for rotation scores for the five configurations yielded significant differences at the .01 per cent level of confidence. The null hypothesis would be rejected since significance is present between the configurations.

The t test to determine the significance of the differences in the means of rotation for configurations was applied. The same formula for the \sqrt{C} DIFF. was used as was employed for sets except that n_0 was substituted for n_2 . In

this case the Significant Difference $\geq 2.604 \times 3.81$ or 9.92.

From Table III it may be seen that configuration three was significantly different from configurations two, four and five. No significance was found between the other configurations. Therefore configuration three is consistently producing a high degree of rotation in comparison to other configurations.

3. Analysis of Data for Main Effect: Groups.

Table I shows that the total rotation scores for the main effect, groups, is significant beyond the .001 per cent level of confidence when tested against the residual variance. Therefore the null hypothesis would have to be rejected because significant differences are present among the groups. Since the F for groups has been found to be significant, t -tests were applied to find where the specific differences occurred. Table IV reports the evaluation of the differences of means on the total rotation scores for the three groups. The same formula was used for the $\sqrt{\text{DIFF}}$, as was used for sets except that n_g was used instead of n_s , the significant difference $\geq 2.604 \times 2.95$ or 7.68. From Table IV, it can be seen that all three groups differ from each other significantly in total mean rotation.

Table III.-

Evaluation of the Difference of Means of the Retention Scores of the Five Configurations by Means of the t-Test.

Configuration Used	Mean Values Compared	Difference	Significant Difference
1-2	14.40-11.30	3.10	No
1-3	14.40-22.55	8.15	No
1-4	14.40- 8.50	5.90	No
1-5	14.40-12.40	2.00	No
2-3	11.30-22.55	11.25	Yes
2-4	11.30- 8.50	2.80	No
2-5	11.30-12.40	1.10	No
3-4	22.55- 8.50	14.05	Yes
3-5	22.55-12.40	10.15	Yes
4-5	8.50-12.40	3.90	No

Table IV.-

Evaluation of the Differences of Means on the Total Rotation Scores of the Three Groups by Means of the t-Test.

Groups Used	Mean Values Compared	Difference	Significant Difference
Normals-Emotional	1.90-15.00	13.10	Yes
Normals-Schizophrenic	1.90-24.62	22.72	Yes
Emotional-Schizophrenic	15.00-24.62	9.62	Yes

4. Analysis of Data of the First Order Interactions: Sets x Groups.

The test for significance of double interaction, sets by groups, using the residual variance as the error term, resulted in a significant interaction. The F-test was significant at the .001 per cent level of confidence. Therefore, the null hypothesis was rejected.

Since double interaction was significant, t-tests were applied to find where the differences occurred. Table V gives the differences of means of the rotation scores of the groups by sets interaction. The same formula for $\sqrt{\text{DIFF.}}$ was used except for the denominator, which now is n_{gs} . For this case, significant difference $\geq 2.604 \times 5.12$ or 13.33. Table V shows that on sets a, b, c, d, and e the normal group was significantly different in mean rotation score from the emotionally disturbed and schizophrenic groups on sets c, d, e, and f. On set f the normals differed significantly from the emotionally disturbed group on sets c, d, and e, but not on set f, while they were found to be significantly different from the schizophrenics on sets c, d, e, and f. There were no significant differences found within the normal group for any of the sets.

The emotionally disturbed group's results on sets a and b were found to differ significantly in mean rotation score from those of the schizophrenic group on sets c, d, e, and f. For sets c and d the emotionally disturbed group was

Table V.-

Evaluation of the Difference between Means for the Rotation Scores of Groups by Sets Interaction by Means of the t-Test.

Groups and Sets	Mean Value	Na	Nb	Nc	Nd	Ne	Nf	EMa	EMb	EMc	EMd	EMe	EMf	Se	Sb	Sc	Sd	Se	Sf
		1.80	1.13	1.93	1.20	1.20	2.60	5.00	5.40	17.40	16.30	29.10	15.90	2.86	6.33	23.10	33.60	25.50	43.30
Na	1.80		.67	.13	.60	.60	.80	3.20	3.60	<u>15.60</u> ^a	<u>14.50</u>	<u>27.30</u>	<u>14.10</u>	1.06	4.53	<u>21.20</u>	<u>21.80</u>	<u>26.70</u>	<u>41.80</u>
Nb	1.13			.80	.07	.07	1.47	3.87	4.27	<u>16.27</u>	<u>15.17</u>	<u>27.97</u>	<u>14.77</u>	1.73	5.20	<u>21.97</u>	<u>22.47</u>	<u>27.37</u>	<u>42.17</u>
Nc	1.93				.73	.73	.67	3.07	3.47	<u>15.47</u>	<u>14.37</u>	<u>27.17</u>	<u>13.97</u>	.93	4.40	<u>21.17</u>	<u>21.67</u>	<u>26.57</u>	<u>41.37</u>
Nd	1.20					.00	1.40	3.80	4.20	<u>16.20</u>	<u>15.10</u>	<u>27.20</u>	<u>14.70</u>	1.66	5.13	<u>21.20</u>	<u>22.40</u>	<u>27.20</u>	<u>42.10</u>
Ne	1.20						1.40	3.80	4.20	<u>16.20</u>	<u>15.10</u>	<u>27.20</u>	<u>14.70</u>	1.66	5.13	<u>21.20</u>	<u>22.40</u>	<u>27.20</u>	<u>42.10</u>
Nf	2.60							1.40	2.80	<u>14.80</u>	<u>13.70</u>	<u>26.50</u>	<u>13.30</u>	.26	3.73	<u>20.50</u>	<u>31.00</u>	<u>35.80</u>	<u>40.70</u>
EMa	5.00								.40	12.40	11.30	<u>24.10</u>	10.90	2.14	1.23	<u>18.10</u>	<u>28.60</u>	<u>28.50</u>	<u>38.20</u>
EMb	5.40									12.00	10.90	<u>23.70</u>	10.50	2.54	.93	<u>17.70</u>	<u>28.20</u>	<u>28.10</u>	<u>37.90</u>
EMc	17.40										1.10	11.70	1.50	<u>14.54</u>	11.07	5.70	<u>16.20</u>	<u>21.10</u>	<u>25.20</u>
EMd	16.30											12.80	.40	<u>13.44</u>	9.97	6.80	<u>17.20</u>	<u>22.20</u>	<u>27.00</u>
EMe	29.10												13.20	<u>22.24</u>	<u>22.77</u>	6.00	4.50	9.40	<u>14.20</u>
EMf	15.90													13.04	8.57	7.20	<u>17.70</u>	<u>22.60</u>	<u>27.40</u>
Se	2.86														3.47	<u>20.24</u>	<u>20.74</u>	<u>25.64</u>	<u>30.44</u>
Sb	6.33															<u>16.77</u>	<u>27.27</u>	<u>28.17</u>	<u>36.27</u>
Sc	23.10																10.50	<u>15.40</u>	<u>20.20</u>
Sd	33.60																	4.90	9.70
Se	25.50																		4.80
Sf	43.30																		

a Underlined numbers significant at .01 level of confidence.

found to be significantly different from the schizophrenic group on sets a, d, e, and f. On set e they differed significantly from the schizophrenics' performance on sets a, b, and f. The emotionally disturbed group's results on set f differed significantly from the schizophrenic group on sets d, e, and f. Within the emotionally disturbed group there was a significant difference found on sets a and b as opposed to set e.

Within the schizophrenic group significant differences were found on sets a and b as opposed to sets c, d, e, and f. Similarly, significant differences were found on set c as opposed to sets e and f.

Further analysis of the data shows that the emotionally disturbed group on all six sets differs significantly from the schizophrenics on set f.

From the above data it can be seen that a hierarchy has been established by the statistics showing that the normals produced the least rotations and the schizophrenics the most.

5. Analysis of Data of the First Order Interactions: Sets x Configurations.

The test of significance of double interactions, sets by configurations resulted in a significant interaction at the .001 per cent level of confidence when using the residual variance as the error term. Therefore the null hypothesis

was rejected.

T-Tests were used to determine where the significance between the means of the sets by configurations existed. Results of the t-tests on sets by configurations are given in Table VI.

The same formula was used for $\sqrt{\text{DIFF}}$, except for the denominator which is now n_{30} . In this instance, significant difference $\geq 2.604 \times 6.61$ or 17.21. It is seen in Table VI that there is a significant difference in mean rotation score between set a, configuration 1 and set b, configurations 1, 3, and 4 on the one hand, and set c, configurations 1 and 3, set d, configuration 3, set e, configurations 2, 3, and 4 and set f, configurations 1 and 5 on the other hand.

On set a, configurations 2, 3, and 4, and set b, configuration 2, there was a significant difference from set c, configurations 1 and 3, set d, configuration 3, set e, configurations 2, 3, and 4 and set f, configurations 1, 2, and 5.

For set a, configuration 5, there was a significant difference from set c, configurations 1 and 3, set d, configuration 3, set e, configurations 2 and 3 and set f, configuration 5.

Set b, configuration 5, was found to be significantly different from set c, configuration 3, set d, configuration 3, set e, configurations 2 and 3 and set f, configurations 1 and 5.

Table VII.-

Evaluation of the Differences Between Means for the Rotation Curves of Sets x Configurations Interaction by Means of the t-Test.

Groups by Sets	Mean Value	s ₁	s ₂	s ₃	s ₄	s ₅	s ₆	s ₇	s ₈	s ₉	s ₁₀	s ₁₁	s ₁₂	s ₁₃	s ₁₄	s ₁₅
41	3.66	2.00	1.22	.66	1.67	.66	1.67	.66	1.67	.66	1.67	.66	1.67	.66	1.67	.66
42	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46
43	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44
44	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
45	5.33	1.33	2.66	1.33	2.66	1.33	2.66	1.33	2.66	1.33	2.66	1.33	2.66	1.33	2.66	1.33
51	4.00	1.00	2.00	1.00	2.00	1.00	2.00	1.00	2.00	1.00	2.00	1.00	2.00	1.00	2.00	1.00
52	3.77	1.11	2.22	1.11	2.22	1.11	2.22	1.11	2.22	1.11	2.22	1.11	2.22	1.11	2.22	1.11
53	3.66	1.11	2.22	1.11	2.22	1.11	2.22	1.11	2.22	1.11	2.22	1.11	2.22	1.11	2.22	1.11
54	3.88	1.11	2.22	1.11	2.22	1.11	2.22	1.11	2.22	1.11	2.22	1.11	2.22	1.11	2.22	1.11
55	7.11	1.78	3.56	1.78	3.56	1.78	3.56	1.78	3.56	1.78	3.56	1.78	3.56	1.78	3.56	1.78
61	22.11	5.53	11.06	5.53	11.06	5.53	11.06	5.53	11.06	5.53	11.06	5.53	11.06	5.53	11.06	5.53
62	17.44	4.36	8.72	4.36	8.72	4.36	8.72	4.36	8.72	4.36	8.72	4.36	8.72	4.36	8.72	4.36
63	25.55	6.39	12.78	6.39	12.78	6.39	12.78	6.39	12.78	6.39	12.78	6.39	12.78	6.39	12.78	6.39
64	4.00	1.00	2.00	1.00	2.00	1.00	2.00	1.00	2.00	1.00	2.00	1.00	2.00	1.00	2.00	1.00
65	6.66	1.67	3.33	1.67	3.33	1.67	3.33	1.67	3.33	1.67	3.33	1.67	3.33	1.67	3.33	1.67
71	17.44	4.36	8.72	4.36	8.72	4.36	8.72	4.36	8.72	4.36	8.72	4.36	8.72	4.36	8.72	4.36
72	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77
73	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77
74	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77
75	12.00	3.00	6.00	3.00	6.00	3.00	6.00	3.00	6.00	3.00	6.00	3.00	6.00	3.00	6.00	3.00
81	24.00	6.00	12.00	6.00	12.00	6.00	12.00	6.00	12.00	6.00	12.00	6.00	12.00	6.00	12.00	6.00
82	29.55	7.39	14.78	7.39	14.78	7.39	14.78	7.39	14.78	7.39	14.78	7.39	14.78	7.39	14.78	7.39
83	34.44	8.61	17.22	8.61	17.22	8.61	17.22	8.61	17.22	8.61	17.22	8.61	17.22	8.61	17.22	8.61
84	22.33	5.58	11.16	5.58	11.16	5.58	11.16	5.58	11.16	5.58	11.16	5.58	11.16	5.58	11.16	5.58
85	17.55	4.39	8.78	4.39	8.78	4.39	8.78	4.39	8.78	4.39	8.78	4.39	8.78	4.39	8.78	4.39
91	26.11	6.53	13.06	6.53	13.06	6.53	13.06	6.53	13.06	6.53	13.06	6.53	13.06	6.53	13.06	6.53
92	20.44	5.11	10.22	5.11	10.22	5.11	10.22	5.11	10.22	5.11	10.22	5.11	10.22	5.11	10.22	5.11
93	16.33	4.08	8.16	4.08	8.16	4.08	8.16	4.08	8.16	4.08	8.16	4.08	8.16	4.08	8.16	4.08
94	16.44	4.11	8.22	4.11	8.22	4.11	8.22	4.11	8.22	4.11	8.22	4.11	8.22	4.11	8.22	4.11
95	25.66	6.42	12.84	6.42	12.84	6.42	12.84	6.42	12.84	6.42	12.84	6.42	12.84	6.42	12.84	6.42

a Underlined numbers significant at the .01 level of confidence

Set c, configurations 1 and 3 was found to be significantly different from set d, configurations 2, 3, and 4. With set e there was a significant difference between configurations 1 and 4 and between configuration 3 on the one hand and 4 and 5 on the other.

Set c, configuration 2 was found to be significantly different from set d, configuration 3 and set e, configurations 2 and 3. Set c, configuration 4, was significantly different from set d, configuration 3, set e, configurations 2, 3, and 4, and set f, configuration 5. Set c, configuration 5, was significantly different from set d, configuration 3, set e, configurations 2 and 3 and set f, configurations 1 and 5.

For set d, configuration 2, there was a significant difference from set e, configurations 2, 3, and 4 and set f, configurations 1, 2, and 5. On set d, configuration 3 there was found a significant difference from sets e and f on all five configurations. Set d, configuration 4, was significantly different from set e, configurations 2, 3, and 4, and set f, configurations 1, 2, 3 and 5. For set d, configuration 5, there was significant difference from set e, configurations 2 and 3. Within set d, configurations 1 and 2 differed significantly from configuration 3 and configuration 3 differed significantly from configurations 4 and 5.

On set e, configuration 1 differed significantly from configuration 3. Set e, configuration 3, differed significantly from set f, configurations 3 and 4.

Further analysis showed that set d, configuration 3, was significantly different from all the other sets for all the configurations.

6. Analysis of Data of the First Order Interactions:
Groups x Configurations.

For the double interaction, groups by configurations, using the residual variance as the error term, the F-test was not significant. Since there was no significance the t-test was not applied and the null hypothesis was not rejected.

7. Analysis of Data of the Second Order Interactions:
Sets x Configurations x Groups.

For the triple interaction, sets by configurations by groups, using the residual variance as the error term, the F-test was not found to be significant. The null hypothesis could not be rejected and there was no need for further analysis by means of the t-test.

A discussion of the data will be considered in the next chapter.

CHAPTER V

DISCUSSION OF THE DATA

The discussion of the data will be considered in relation to the seven hypotheses which were formulated at the end of the second chapter. The hypotheses will be discussed in the order in which they were set out.

1. Discussion of the Sets.

It was shown in the last chapter that sets c, d, e, and f produced the most rotation. This supports the rationale that certain stimulus variations of the Bender test in terms of variation of figure and ground will influence rotation.

The first variation, comparing set a to set c, showed that when a figure was placed in a vertical position as opposed to a horizontal position more rotation was induced. This was only true when the rectangular ground was in a horizontal, as opposed to vertical, position, as in set b. Therefore when a figure is in a vertical position and incongruent to the ground shape, then more rotation is produced.

The next variation which compared set a, horizontal figure on a horizontal ground, to set d, horizontal figure on a vertical ground, showed that more rotation was produced by the latter. Again there is an incongruent figure and ground orientation that is producing more rotation. In this case it

appears that the ground shape, as in set d, is the most influential factor, while in set c, the figure influenced rotation more. It should be pointed out that set b, in which both figure and ground are vertical, produced only a small degree of rotation. Possibly, therefore, the most important factor is not the figure alone, as in set c, or ground alone, as in set d, but the incongruency of either figure to ground or ground to figure.

In the next variations where the rectangular shape was changed to a diamond shape and the figure remained in a horizontal position as in set e, significantly more rotation was produced than in sets a and b and even more than sets c and d, though these latter differences were not significant. Thus, when the ground shape is changed to a more difficult form such as the diamond, more rotation is produced. Here then it would seem that the ground shape is an influential factor in producing rotation. An additional factor operating in this case is the incongruency of the figure to the ground shape.

The last variation, set f, was a diamond shaped ground with a vertical figure. This variation produced more rotation than all the other sets except set e.

It may be concluded, therefore, that

1. a vertically orientated figure produced more rotation than a horizontally orientated figure when the same ground shape was used and as long as there was incongruency between figure and ground;
2. also, when the ground shape was vertical and incongruent to the figure there would be more rotation produced. In fact more than would be found in point one above;
3. a diamond orientated ground produced more rotation than a rectangular orientated ground regardless of the position of the figure. A diamond orientated ground when incongruent to the figure shape produced more rotation than when it was not.

2. Discussion of the Configurations.

From Chapter IV it was seen that configuration 3 contributed significantly more to rotation than the other four configurations. Configuration 1 followed closely behind configuration 5. This observation lends support to the rationale that the configurations are not equivalent items and therefore will contribute differently to the amount of rotation produced. Taking a closer look at these two configurations it can be seen that configuration 1 is the only configuration to be composed of two figures. According to Bender¹ configuration 1 is identified as two contingent figures because each represents a "gute gestalt". Possibly

¹ Laretta Bender, op. cit., p. 4-5.

it contributes more to production of rotation because an individual has to be able to integrate both of them into a whole gestalt. If a subject cannot handle the configuration as a whole unit, he will deal with the configuration as if they were isolated details which might make proper orientation of the configuration more difficult. On the other hand, since a diamond has poorer form than a circle, an individual might be distracted by either the stronger form or the weaker one, thus making it harder to orientate the configuration. This seems to stress the importance of the relative strength of competing perceptual organization. A study by Fisichelli² lends support to this supposition. He found that one of the variables which affects fluctuation of Lissajous figures is the complexity and competing forces of form which increased the amount of rotation and reversals.

For configuration 3 which is based on the principle of proximity of parts, it seems that the very structure of the configuration is the basis for its producing more rotation. It has been shown³ that this is the most difficult configuration to reproduce and is not fully mastered until age eleven. Thus, the very nature of configuration 3 makes

² V. A. Fisichelli, "Reversible Perspective in Lissajous Figures, Some Theoretical Considerations", American Journal of Psychology, Vol. 60, 1947, p. 240-249.

³ Laretta Bender, op. cit., p. 132-135.

it difficult for an individual to maintain a proper orientation when reproducing it.

In other words, the subject had trouble encompassing the total gestalt and dealt with configurations 1 and 3 as if they were isolated forms. Thus, the misinterpretation of the forms could produce rotation because there were not enough cues available to the subject to perceive the configurations as a whole.

3. Discussion of the Groups.

In Chapter IV it was shown that the three groups differed significantly in mean rotation scores. This finding supports the rationale that rotation is influenced by a lack of cue utilization due to emotional excitation, arousal or disturbance. That is, the amount of rotation which would take place is at least to some extent a function of the conflict between those factors inducing rotation (configuration and sets) and those factors working against rotation (availability of visual directional cues in the groups). It follows, therefore, that the more disturbed an individual is, the fewer visual cues he will have available to orientate himself to those sets producing rotation.

The emotionally disturbed and schizophrenic groups, being more disturbed, would, therefore, be less aware of the surrounding stimuli that are important for visual cues. When

compared to the normal group they should rotate more because there will be available to them fewer rotation-counteracting cues and hence they will be more influenced by the rotation-producing sets.

It was seen that the emotionally disturbed and schizophrenic groups showed great variability, some subjects rotating a great deal, others rotating very little. The variations in rotation that could occur could depend upon the degree of disturbance or possibly on how successfully the subject compensates for the lack of visual cues available to normal subjects.

4. Discussion of Sets x Groups Interaction.

In the analysis of data in Chapter IV it was shown that the interaction of sets by groups was significant. This indicates that not only were the groups, sets and configurations contributing to production of rotation individually but a combination of two or more of these factors was influencing rotation, the first combination being groups by sets. Therefore, cue utilization and figure-ground orientation were both operating in production of rotation.

In the case of the normal group which was assumed to be able to use all the cues necessary at any one time for an appropriate response because of the lack of emotional excitation, arousal or disturbance, there was no difficulty

in handling the conflict between the rotation producing sets, regardless of their figure-ground orientation and factors working against rotation such as availability of cues.

The normal subjects were able to counteract the rotation-inducing stimuli (diamond shaped ground and vertical figure and rectangular vertical ground orientation), since the usual visual cues were available to them.

This is brought out even more clearly by the fact that the two disturbed groups differed significantly in mean rotation scores on sets c, d, e, and f, which were found to produce more rotation, from the normal group on all the sets.

This means that the two disturbed groups were affected both by the figure-ground orientation and amount of cue utilization available. They were not able to handle or cope with the conflict between the rotation producing sets and factors working against rotation such as availability of cues. Taking into consideration their disturbance plus the fact that when faced with a more difficult set to orientate, it might be possible for them to become more aroused and excited. Therefore they could not draw on enough of the cues available to them to counteract the rotation producing sets.

In regard to the emotionally disturbed groups sets c, d, e, and f resulted in the most rotation with set e

producing the highest degree of rotation of the four sets. That is, the diamond orientated ground and horizontal figure was the combination which the emotionally disturbed group rotated the most.

In the case of the schizophrenic group sets c, d, e, and f again produced rotation with set f producing significantly more rotation than the emotionally disturbed group or the normal group produced on all six sets. For the schizophrenic group, then, the diamond orientated ground and vertical figure was the combination which produced the most rotation. The schizophrenic group was even less aware of surrounding cues and more dependent on the directional qualities of the cards than the emotionally disturbed or normal groups, presumably because of greater severity of emotional disturbance, arousal and excitation.

In reference to the vertical and horizontal directional qualities of the sets, Asch and Witkin⁴ have shown parallel results; they demonstrated that under conditions of reduced cue availability lines which were not, in fact, vertical would tend to be seen as vertical, and lines which were not, in fact, horizontal would tend to be seen as horizontal. The theory being that our main directional lines

⁴ S. E. Asch and H.A. Witkin, "Studies in Space Orientation, Perception of the Upright with Displaced Visual Fields and with Body Tilted", Journal of Experimental Psychology, Vol. 38, 1948, p. 455-477.

or orientation are the vertical and horizontal and, in the absence of other information, people tend to accept as vertical and horizontal lines which are nearly so. Another closely related study was the one by Holway and Boring⁵ in which they showed that there was a direct relationship between the amount of cue-reduction and the apparent size of the object. As the number of visual cues was reduced, so the apparent size of the object approached more nearly its objective or retinal size.

In summary, then, the most striking phenomenon is the absence in the normal group of any influence by the figure-ground orientation or availability of cues. While by contrast the most powerful influences in the emotionally disturbed and schizophrenic groups which produced the rotation effect was firstly the orientation of the ground shape. When the ground shape was a diamond, a great deal of rotation was produced; when the ground shape was a rectangle, very little was produced. The exception being when the rectangle was in a vertical position. Secondly, when the figure shape is incongruent to the ground shape more rotation is produced than when it is congruent. The exception here being when there was a diamond ground and vertical

5 A. H. Holway and E. G. Boring, "Determinants of Apparent Visual Size with Distance Variant", American Journal of Psychology, Vol. 54, 1941, p. 21-37.

figure.

5. Discussion of Sets x Configurations.

In this combination there was a significant interaction found. This means that both figure-ground orientation and configurations together were operating to produce rotation.

For configuration 1 most rotation was produced when used with sets c and f. The factor common to both sets was the placement of configuration 1 in the vertical position.

For configuration 2 the most rotation was produced when it was used with sets e and f. The common factor in these two sets was the diamond shape.

The greatest amount of rotation was produced when configuration 3 was combined with sets c, d, and e. The one factor that stands out in these sets is that the figure is always incongruent to the ground. It should be pointed out that set d produced significantly the most rotation in relation to all the other sets when using configuration 3. In set d the figure-ground orientation was a rectangular shaped ground in the vertical position and the figure in the horizontal position. Therefore, a subject must have been able to handle the structure of the most difficult configuration and at the same time the verticalization effect.

Configuration 4 produced the most rotation when combined with set e. In this case, a horizontal figure was on a diamond background. For configuration 5 the most rotation was produced when it was combined with set f in which a vertical figure was on a diamond shaped ground.

In summary, it can be seen that many of the configurations, when considered alone were not significant in producing rotation, but produced more rotation when used with a particular set.

Configuration 3, set d, was the one combination that stood out as it produced significantly more rotation than all the other combinations of sets and configurations. The other important point is that all the configurations produce more rotation when combined with either set e or f. In both these cases the background shape was a diamond. It can be seen from the above that both the figure-ground orientation and configurations when combined produced rotation.

6. Discussion of Groups x Configurations Interaction.

In the analysis of groups by configurations there was no significant interaction found. Although the groups and configurations were individually significant when combined together they were not dependent upon each other. That is, there was no one group that rotated significantly more on one configuration than another.

7. Discussion of the Triple Interaction
Groups x Sets x Configurations.

In Chapter IV it was shown that the triple interaction was not significant. This means that no one particular group on any one particular set for any one configuration produced significantly more rotation than another such combination.

The investigator has presented a discussion of the data, as well as some interpretation of these findings. Attention will now be turned to the summary and conclusions.

SUMMARY AND CONCLUSIONS

The primary purpose of this research study was to investigate whether rotation on the Bender-Gestalt cards may be influenced by stimulus variation, cue utilization or a combination of the two. Stimulus variation was considered in relation to the manipulation of figure-ground and figures, figure in terms of a vertical-horizontal orientation and ground in terms of diamond-rectangular orientation. These two variations were designated by the term sets. The figures themselves were not equivalent items and were called configurations. Range of cue utilization was considered an index of cerebral competence which might be reduced by emotional excitation, arousal or disturbance and was considered in relation to groups. Three groups of children were chosen between the ages of eight and fifteen. These three groups were: normal, emotionally disturbed and schizophrenic. There were ninety children in each group which made a total of 270.

The test consisted of six sets with five cards in each set. The first set contained the original Bender figures and cards and the remaining five sets were varied according to the vertical-horizontal and diamond-rectangular orientation.

Following the above rationale comparisons were made. It was hypothesized that:

1. There is no significant difference between the amount of rotation produced by any two of the six sets of cards.
2. There is no significant difference between the amount of rotation produced by any two of the five configurations.
3. There is no significant difference between the amount of rotation produced by any two of the three groups.
4. There is no significant interaction between the six sets and the five configurations in the amount of rotation produced.
5. There is no significant interaction between the six sets and the three groups in the amount of rotation produced.
6. There is no significant interaction between the three groups and the five configurations in the amount of rotation produced.
7. There is no significant interaction among the six sets, five configurations and the three groups in the amount of rotation produced.

Using a three dimensional analysis of variance and t-tests for the investigation, it was concluded that:

1. The three groups differed significantly in the amount of rotation produced. Since the groups were selected in terms of severity of disturbance it was shown that a hierarchy existed in rotation with the normals producing the least and schizophrenics the most. It has been shown then that the range of cue utilization is reduced in cases of emotional disturbance, arousal and excitation thus producing more rotation because of the lack of cues.
2. There was significance found among the sets with four of the six combinations producing more rotation. It was found that the vertical orientation produced more than the horizontal, and the diamond ground orientation produced more than the rectangular.
3. There were significant differences among the configurations, with configuration 3 producing the most rotation followed by configuration 1.
4. There was a significant interaction found between groups by sets. This indicated that the range of cue utilization and figure-ground orientation were operating together in certain combinations to produce rotation.

5. There was no significant interaction found between groups by configurations.
6. There was a significant interaction found between sets by configurations. This meant that both the figure-ground orientation and configuration together in certain combinations were producing the most rotation.
7. There was no significant interaction found among groups by sets by configurations.

Two factors that are important then in understanding rotation are figure-ground orientation and cue availability.

1. Suggestions and Considerations for Future Research.

Since cue availability was important in counter-acting rotation the next step would be an investigation of some of the available stimuli which a subject might need for a proper visual orientation. This might include such things as the table edge or direction of the grain of the table, body position of the subject, size of the room, distance of subject from test cards and peripheral versus central vision in relation to where examiner is seated.

Another consideration would be in the direction of a cross validation study. This would mean taking sets d, e, and f combined with configurations 1 and 3 and administering them to the same kind of population used in this study to see if consistent results would be found. If significant results were found, the next step would be to establish a cutoff score for rotation for the three groups. Other pathological groups besides the two used in this study could also be

administered the new sets to see what kind of results would be obtained. The ultimate goal being a more refined diagnostic tool for screening pathological groups.

It is reasonable to suppose that other factors play a significant role in the rotation effect and among these would probably be individual differences in personality structure and certain aspects of the development of perception, such as, the difference in the developmental sequence for parts-of-a-field and field-as-a-whole. With regards to parts-of-a-field what would be the developmental sequence in terms of an item being influenced by the structure of the surrounding field? Further analysis of these factors would probably add considerably more in understanding the dynamics behind the rotation effect.

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Aseh, S.E. and H.A. Witkin, "Studies in Space Orientation. I. Perceptions of the Upright with Displaced Visual Fields", Journal of Experimental Psychology, Vol. 38, No. 3, 1948, p. 325-337.

They carried out experiments concerned primarily with the process of orientation and proposed that perception of the upright is a function that people must depend upon in their practical relations with objects and body movements. They found that errors in the perception of the vertical varied according to the amount of information available from a surrounding room which also was varied.

Bender, Laretta, "A Visual Motor-Gestalt Test and Its Clinical Use", American Orthopsychiatric Association Monograph, No. 3, 1936, p. vi-176.

The author introduced a visual-motor test to explore the gestalt function in perception and developed normative data for each age level from three to twelve years. The final test consisted of nine geometric figures which were to be used as an objective estimate of maturation level.

Boring, Edwin G., "Visual Perception as Invariance", The Psychological Review, Vol. 59, No. 2, 1952, p. 141-148.

Proposed that a stimulus-object has a number of properties. These properties of the stimulus object may be of greater or lesser importance in producing a response.

Byrd, Eugene, "The Clinical Validity of the Bender-Gestalt Test with Children: A Developmental Comparison of Children in Need of Psychotherapy and Children Judged Well-adjusted", Journal of Projective Techniques, Vol. 20, No. 2, p. 127-136.

He showed that two groups of children responded differently to the different Bender-Gestalt figures. Each figure elicited a variety of responses and also provided evidence that rotation was a differential variable in picking out the groups.

Callaway, E. and E. Dembe, "Narrowed Attention: Psychological Phenomenon that Accompanies a Certain Physiological Change", Archives of Neurology and Psychiatry, Vol. 79, 1958, p. 74-90.

They studied focusing of subjects in relation to central attentional processes. It was formulated that the attentive field tends to become narrowed by emotion or under the influence of increased activity in the brain stem reticular formation.

Cameron, Norman, The Psychology of Behaviour Disorders, New York, McGraw-Hill Company, 1947, p. 540-575.

In a biosocial approach to emotions he proposed that emotions reduce a person's ability to perform because all the necessary cues to make an appropriate response are no longer available.

Casperson, Roland, "The Visual Discriminations of Geometric Forms", Journal of Experimental Psychology, Vol. 40, No. 5, 1950, p. 668-682.

The author obtained discriminative data for thirty solid geometric figures consisting of five variations in the construction of each of six basic forms. These forms were: diamond, eclipse, triangle, rectangle, cross and star. He found that the rectangle, in relation to the diamond, had better form and simpler structure.

Easterbook, J.A., "The Effect of Emotion on Cue Utilization and the Organization of Behaviour", Psychological Review, Vol. 66, No. 3, 1959, p. 183-201.

He discussed cue utilization in relation to the amount of information used. And found that emotions tended to reduce the range of cue utilization by improving the amount of information available.

Fabian, A. A., "Vertical Rotation in Visual Motor Performance: Its Relationship to Reading Reversals", Journal of Educational Psychology, Vol. 36, 1945, p. 129-154.

He found that emotionally disturbed children tend to rotate the horizontally orientated Bender designs to the vertical. In the same study, using normal children between the ages of five and nine years, it would found that rotation up to the age of seven was expected. This was attributed to a developmental phenomenon which is corrected after the age of seven.

Goldstein, K. and M. Scheerer, "Abstract and Concrete Behaviour: An Experimental Study with Special Tests", Psychological Monogram, Vol. 53, No. 239, 1941, p. 32-57.

They were interested in figure-ground orientation in relation to a subject's ability to copy colored designs with blocks. They found that in brain-damaged subjects there was trouble in differentiating between the design as the figure, and the white surrounding card area as the ground. They discovered that the vertical position caused more failures than a horizontal position. When the preferred configuration was changed or interfered with by incongruency in positional relation between the figure and the ground, performance was made more difficult.

Helsen, Harry and E.V. Fehrer, "The Role of form in Perception", American Journal of Psychology, Vol. 44, 1932, p. 79-102.

In a study dealing with form, they found that when all criteria are considered the rectangle had the best form and the diamond figure the poorest.

Jenkins, M., "Affective Processes in Perception", Psychological Bulletin, Vol. 54, 1957, p. 100-127.

Studying the utilization in perceptual tasks he found that when there was some degree of vagueness or equivalence in perceiving objects, there was a narrowing of attention. This was attributed to an emotional component.

Koppitz, Elizabeth M., "The Bender-Gestalt Test and Learning Disturbances in Young Children", Journal of Clinical Psychology, Vol. 14, No. 3, 1958, p. 292-295.

In a study of seventy-seven children with learning disturbances she found that Bender figures A, 1, 3, and 7 produced the most rotation.

Shapiro, M.B., "Experimental Studies of a Perceptual Anomaly. III. Confirmatory and Explanatory Experiments", Journal of Mental Science, Vol. 98, 1952, p. 605-617.

Shapiro considered rotation to be an anomaly of perception and a function of disturbed figure-ground relations on the Blocks Design test. He associated brain damage with rotation and found that when figure and ground are of the same shape and similarly orientated rotation is at a minimum. He also found that square orientation of a figure produced less rotation than a diamond orientation.

-----, "Experimental Studies of a Perceptual Anomaly. III. The Testing of an Explanatory Theory", Journal of Mental Science, Vol. 99, 1953, p. 394-409.

It was found that normal subjects, when deprived of most of their visual directional cues while performing the Block Design test, would rotate as much as brain-damaged subjects. This was attributed to an exaggerated inhibitory effect.

Witkin, H.A. and S.E. Ash, "Studies in Space Orientation. III. Perception of the Upright in the Absence of a Visual Field", Journal of Experimental Psychology, Vol. 38, 1948, p. 603-614.

Normal subjects were deprived of all directional cues by being placed in a dark room and they demonstrated that for many of the subjects, perception of the upright was a function of the visual directional cues available and that these

ues are stable properties of certain features of visual stimulation.

Yates, Aubrey J., "Rotation of Drawing by Brain-Damaged Patients", Journal of Abnormal and Social Psychology, Vol. 53, 1956, p. 178-181.

Subjects were requested to make drawing of the Block Design Test and he found that figures in a vertical position influenced rotation more than figures in a horizontal position. He also found that a diamond-orientated ground produced more rotation than a square-orientated ground.

APPENDIX 1

ABSTRACT OF

Factors Influencing Rotation on the Bender-Gestalt Performance of Children¹

The main concern of this study was with the rotation effect on the Bender-Gestalt performance of children. An attempt was made to put forth some of the underlying rationale to account for this rotation effect. The rationale proposed states that rotation might be influenced by stimulus variation, cue utilization or a combination of the two. Stimulus variation was manipulated in three ways: figure variation in terms of vertical-horizontal orientation, ground in relation to a rectangular-diamond shape and figures since they were considered to be non-equivalent items. Cue utilization was considered as an index of cerebral competence and to be affected by emotional disturbance, excitation or arousal. For clarity the figure-ground variations were designated as sets, the figures were called configurations and range of cue utilization considered in terms of groups.

The subjects consisted of 270 children, between the ages of eight and fifteen, ninety normals, ninety emotionally disturbed and ninety schizophrenics. The instrument used

¹ Jerry B. Fuller, doctoral thesis presented to the School of Psychology and Education of the University of Ottawa, Ontario, 1960, viii-79.

consisted of six sets of cards with five cards in each set making a total of thirty cards. The first set consisted of five of the original Bender-Gestalt cards, with the other five sets varied according to the vertical-horizontal and rectangular-diamond orientations.

The main hypothesis to be tested was that there were no significant differences among groups, sets, configurations or a combination of the two or more of the above factors.

Interpretation of the results showed that there was a significant difference among the groups which indicated that the more emotionally disturbed, excited or aroused an individual was the less he was able to draw on the necessary cues to avoid rotation. There was also significant differences found among the sets. It was shown that a vertically orientated figure produced more rotation than a horizontal one. The diamond shape produced more rotation than the rectangular shape. For the configurations it was found that configuration 3 produced the most rotation followed closely by configuration 1.

A combination of groups by sets was significant which shows that both the availability of cues and figure-ground orientation were operating in producing more rotation.

The combination of sets by configurations was significant indicating that figure-ground orientation and configurations together were producing more rotation.

Further research should be concerned with discovering what cues are important to children for a correct visual orientation. A cross-validation study is needed, especially with the last three sets when combined with configurations 1 and 3.

Other factors that might play a significant role in the rotation effect, such as individual differences in personality structure and developmental aspects of perception, should also be investigated.

