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THE EFFECT OF SOME STIMULUS VARIATIONS  
ON THE ROTATION OF BENDER-GESTALT CONFIGURATIONS  
IN NON-PATIENT YOUNG ADULT FEMALES

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## CURRICULUM STUDIORUM

Virginia Elizabeth Schoen was born March 30, 1926, in Toledo, Ohio. She received the Bachelor of Science degree in Chemistry from the College of Saint Teresa, Winona, Minnesota, in 1948. She received the Master of Arts degree in Clinical Psychology from the Catholic University of America, Washington, D. C., in 1954. The title of her thesis was A Study of the Degree of Regression Distinguished Between Alcoholic Paranoid Patients and Non-Alcoholic Paranoid Patients by Means of the Bender Visual-Motor Gestalt Test.

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## INTRODUCTION

In the large volume of research conducted on the Bender-Gestalt test, various ways in which a subject's reproduction of the gestalten may deviate from the original stimulus configuration have been noted. Research has also shown that certain deviations are frequently associated with specific types of pathology. Knowledge that these deviations occur is not sufficient. It is also necessary to know why they occur.

Bender would account for these deviations both in terms of factors within the subject and in terms of the nature of the stimulus. This thinking is reflected in her statement that "The whole setting of the stimulus and the whole integrative state of the organism determine the pattern of the response."<sup>1</sup> With few exceptions, existing research on the Bender-Gestalt has focused its attention on the integrative state of the organism. Here reference is made to the influence of such variables as maturation level, intelligence, psychiatric disturbance and central nervous system pathology. Few studies have attempted to understand the role played by the stimulus in determining the ultimate response.

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<sup>1</sup> Laretta Bender, "A Visual Motor Gestalt Test and Its Clinical Use", American Orthopsychiatric Association, Research Monographs, No. 3, 1938, New York, p. 4.

The present research was geared to the study of the influence of three different stimulus properties on the occurrence of one specific deviation, namely, rotation. Rotation is said to exist when, in copying the design, the subject's final reproduction is turned on its axis relative to the position of that axis in the original stimulus.

Some research has already been devoted to an evaluation of the role played by the stimulus in the occurrence of Bender rotation. These research projects, however, have largely been restricted to a study of the phenomenon as it occurs in the reproductions of children and psychiatric in-patients. The purpose of the present research was to verify and extend the limited existing knowledge on the stimulus variables involved in the rotation of Bender configurations by an adult, non-patient population. It was felt that the role played by the stimulus can best be evaluated when the picture is not clouded by the complicating factors of central nervous system pathology, psychiatric disturbance, etc. Three Bender figures will be presented in three different orientations on four different ground shapes.

The review of the literature with respect to this problem will be presented in the first chapter. This chapter will discuss the stimulus properties of visual forms and related Gestalt propositions, stimulus variation and the rotation of block designs, and stimulus variation and the

rotation of Bender-Gestalt configurations. This chapter is concluded by a summary of the preceding research and a statement of the general hypothesis.

The second chapter outlines the experimental design. Included will be: 1) a description of the subjects, 2) a description of the instrument and statement of the specific hypotheses, 3) the procedures employed for testing and scoring the reproductions and 4) the statistical procedures employed in analysis of the data.

The presentation and discussion of the experimental results are handled in the third chapter. This chapter is followed by a summary of the experimental findings and statement of the resultant conclusions.

## CHAPTER I

### REVIEW OF THE LITERATURE

This chapter will first deal briefly with a general discussion of the stimulus properties of visual forms and with a presentation of some Gestalt propositions considered pertinent to a rationale for the occurrence of the rotation phenomenon. Two subsequent sections present existing research centering around the relationship between stimulus variation and the occurrence of rotation, as manifested in the construction of block designs and the reproduction of the Bender-Gestalt configurations. From this review of the literature, the final section will conclude to a statement of the general hypothesis.

#### 1. Stimulus Properties of Visual Forms and Related Gestalt Propositions.

Basic to a discussion of stimulus variation with respect to the perception of visual form is a consideration of the stimulus properties of such forms. A visual form embodies many properties. Some of these properties may be varied and induce little change in the response. Other variations of the stimulus result in an entirely different response. Relative to this problem Boring states,

...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, of other characteristics.<sup>1</sup>

More specifically, Köhler<sup>2</sup> contends that a visual form remains invariant despite variations in hue, size, brightness and location. That is, the size, hue, brightness, of a visual form may be varied but there is little change in the resulting response. With respect to location he is careful to specify, however, that shape will be affected if an object is shifted too far toward the periphery of the field of vision.

According to Köhler, shape is the most important quality of a visual form, but he holds that other characteristics are closely related. Here reference is made primarily to the ground within which the shape is presented and to the orientation of the figure to the ground. Within the framework of Gestalt Psychology several basic propositions dealing with the inter-relationship of these three variables have been formulated. The rationale for the present research, based primarily on these propositions as formulated

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1 Edwin G. Boring, "Visual Perception as Invariance", Psychological Review, Vol. 59, No. 2, March 1952, p. 144.

2 Wolfgang Köhler, Gestalt Psychology, New York, New American Library, 1959, p. 117-120.

by Helson,<sup>3</sup> is as follows:

Every configuration possesses at least two distinct characteristics. There is a background called ground and a figured portion called figure. Figure and ground have different properties but mutually influence each other. In order for a figure to be seen, the ground must be inhomogeneous to the figure. Where figure and ground are homogeneous it is questionable whether they should even be called configurations. Further, even where figure and ground remain inhomogeneous, changes in the ground tend to influence the perception of the figure. Commenting on this Fuller and Laird state,

...a square may be perceived as a diamond or a square, depending upon its spatial orientation. The framework encasing the square, depending upon whether it is horizontal, vertical, or angulated, influences one's spatial orientation. The square effect is more easily perceived when the framework is horizontally oriented with the figure, i.e., has the same common fate. However, as the frame begins to rotate toward the vertical so that it becomes incongruent, the figure becomes more ambiguous, the square effect diminishes, and a different figure begins to take shape. The more congruent the figure and ground, the more stable is the perception, the more incongruent the less stable the perception.<sup>4</sup>

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<sup>3</sup> Harry Helson, "The Fundamental Propositions of Gestalt Psychology", The Psychological Review, Vol. 40, No. 1, January 1933, p. 13-32.

<sup>4</sup> Gerald B. Fuller and James T. Laird, "The Minnesota Percepto-Diagnostic Test", Special Monograph Supplement, Vol. 19, No. 1, of the Journal of Clinical Psychology, issue of January 1963, p. 8.

Hence the perception of visual form is, in part, a function of the homogeneity or inhomogeneity that exists between figure and ground and is also influenced by changes in the ground.

Further consideration must be given to the types of configurational phenomena and the laws governing configurational changes. Configurations may be 'good' or 'bad', open or closed, complete or incomplete, strong or weak. The strength or weakness of a configuration depends on the degree of cohesion among its members. A weak configuration is subject to change. The major law governing configurational changes is the Law of Prägnanz. This law holds that configurations tend to become as 'good', precise, and impressive as possible. In so doing they change toward a more uniform, level state in which differences tend to be obliterated. They strive to become simple, symmetrical, balanced and well proportioned. Within a whole, parts having a poor position may be made more impressive by a change of position or function.

The present writer proposes that these Gestalt principles of perception are directly pertinent to the occurrence of the rotation phenomenon in the reproduction of Bender-Gestalt configurations. The inhomogeneity of figure and ground is a necessity for this study, obviously exists, and will not be varied. It is contended, however, that by

varying figure-ground-orientation combinations the 'goodness' and resultant stability of the configuration will also be modified and rotation will occur accordingly. In other words, the less stable the configuration the greater the tendency toward rotation.

Although the present research deals specifically with the rotation of Bender configurations, the review of the literature will proceed with a presentation of key research dealing with the rotation of block designs. This approach has been taken because the rotation phenomenon has been most systematically studied as it is manifested in the reproduction of block designs.

## 2. Rotation of Block Designs.

The major research dealing with the rotation of block designs has followed a very definite and logical sequence, with each succeeding study developing naturally from those which preceded. This cohesiveness, so often lacking in psychological research, resulted from a series of studies originated by Shapiro. To establish a frame of reference for the Shapiro studies, it is first necessary to briefly review

certain aspects of the earlier findings of Goldstein and Scheerer.<sup>5</sup>

In their analysis of abstract and concrete attitudes, Goldstein and Scheerer observed that some brain-damaged subjects correctly reproduced the Kohs Blocks designs but would leave the completed pattern in a rotated position. This phenomenon was attributed to an inability of the subject to deal effectively with various figure-ground relationships. One of the relevant factors was shown to be the positional relationship between figure (design) and the surrounding ground. In the presence of the concrete attitude, figure-ground relationships presenting increasing levels of difficulty in reproduction were as follows: 1) both design and surrounding ground oriented on a horizontal base, 2) design on a horizontal base with surrounding ground on an angle, 3) design oriented on an angle with surrounding ground on the same angle and 4) design oriented on an angle with surrounding ground on a horizontal base. These findings were interpreted in terms of the Gestalt Law of Prägnanz, with the position on a horizontal base being considered more natural and more concrete than an angular position.

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<sup>5</sup> Kurt Goldstein and Martin Scheerer, "Abstract and Concrete Behavior: An Experimental Study with Special Tests", in the Psychological Monographs, Vol. 53, No. 2, Whole No. 239, 1941, p. 32-57.

With these findings in mind Shapiro<sup>6</sup> set out to formulate a hypothesis or group of hypotheses that would serve as a basis for predicting the frequency of occurrence of the block design rotation effect. The original hypotheses were based directly on the four figure-ground relationships outlined by Goldstein and Scheerer and were as follows:<sup>7</sup> 1) square orientation of a figure would tend to diminish the frequency of appearance of the anomaly, 2) diamond orientation of a figure would tend to increase the appearance of the anomaly, 3) congruent figure-ground arrangements of the material would tend to decrease the frequency of rotation, while incongruent arrangement would increase frequency, and 4) where the influence of congruence and figure orientation are in conflict the influence of figure orientation is more potent.

While the predicted order was not wholly obtained, analysis of the data suggested that a previously unconsidered variable, the orientation of the line of symmetry of a figure, was operative in determining the frequency of appearance of rotation. The "line of symmetry" was defined as an imaginary line which cuts the design into mirror

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<sup>6</sup> M. E. Shapiro, "Experimental Studies of a Perceptual Anomaly: I. Initial Experiments", Journal of Mental Science, Vol. 97, No. 406, January 1951, p. 90-110.

<sup>7</sup> Ibid.

images. As a result of these findings the initial hypotheses were revised. New hypotheses were tested and the predicted frequency of occurrence of the rotation phenomenon was obtained. Since only one subject was used in this study, additional experimentation was needed to confirm and explain the results.

In 1952 and 1953 Shapiro<sup>8,9</sup> reported two subsequent studies. These studies resulted in the development of what is now known as the Block Design Rotation Test and extended the previous research to samples of normal, brain-damaged and non-brain-damaged psychiatric patients. Certain consistencies with which the rotation phenomenon occurred were observed and formulated into three laws:

1. When the line of symmetry is at an angle to the vertical axis of the total visual field...the tendency to rotate will be increased. When the line of symmetry is parallel to the vertical axis of the visual field, then the tendency to rotate will be lessened.<sup>10</sup>

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<sup>8</sup> M. B. Shapiro, "Experimental Studies of a Perceptual Anomaly: II. Confirmatory and Explanatory Experiments", Journal of Mental Science, Vol. 98, No. 413, October 1952, p. 605-617.

<sup>9</sup> M. B. Shapiro, "Experimental Studies of a Perceptual Anomaly: III. The Testing of an Explanatory Theory", Journal of Mental Science, Vol. 99, No. 416, July 1953, p. 394-409.

<sup>10</sup> Ibid., p. 395.

2. When the design is in a square orientation... then the tendency to rotate will be decreased. When the design is in a diamond orientation... the tendency to rotate will be increased except when in conflict with the angle of line of symmetry which is stronger...<sup>11</sup>
3. ...when the ground is in a diamond orientation...the tendency to rotate will be increased, and when it is in a square orientation ...the tendency to rotate will be decreased, except when in conflict with either symmetry<sup>12</sup> or figure effects, which are both stronger.

The block design rotation effect was found to occur with significantly greater frequency in brain-damaged psychiatric patients than in non-brain-damaged psychiatric patients. Shapiro explained this finding essentially in terms of 1) the law of negative induction, 2) the exaggerated inhibitory effects associated with brain damage and 3) the dependency of perception on the availability of directional cues. He reasoned that the inhibitory aspect of negative induction is exaggerated in the brain-damaged subject. Therefore, when focusing his attention on a stimulus object the surrounding perceptions available to a normal subject are not available to the brain-damaged. The brain-damaged subject is thus unable to counteract the rotation inducing properties of the stimulus cards. The stimulus properties

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<sup>11</sup> Ibid., p. 396.

<sup>12</sup> Ibid., p. 396.

of figure orientation, ground orientation and line of symmetry are free to exert their influence.

Carrying his thinking one step further, Shapiro then postulated that a non-brain-damaged subject with restricted peripheral vision should rotate to a degree comparable to that of the brain-damaged. To test this more rigorous hypothesis, normal subjects, fitted with a "field-reducer"<sup>13</sup>, reproduced the designs on a table covered with black felt. It was found that these subjects, whom he considered to be "pseudo-brain-damaged" rotated significantly more than controls, and in accord with the previously established laws. An unexplained finding was that "normals rotate more than non-brain-damaged psychiatric patients".<sup>14</sup>

Working closely with Shapiro, Yates<sup>15,16</sup> reported two additional studies using the Block Design Rotation Test. In these studies the author attempted to define more accurately the conditions under which the block design rotation

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13 An eye mask which restricted peripheral vision.

14 Shapiro, Op. cit., p. 406.

15 A. J. Yates, "Experimental Studies of a Perceptual Anomaly: IV. The Effect of Monocular Vision on Rotation", Journal of Mental Science, Vol. 100, No. 421, October 1954, p. 975-979.

16 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, 1956, p. 761-771.

effect could be induced in normal subjects. His major conclusions were that the size of the room, distance of the stimulus card from the edge of the table, and previous experience of the subjects in reproducing block designs do not significantly affect the frequency with which rotation occurs. There was a significant increase in occurrence of rotation when the designs were reproduced on black felt as opposed to a wood surface. This finding was attributed to the absence of directional cues from the graining of the wood. No significant relationship was found between intelligence and rotation when a group of student nurses served as subjects.

In an independent study Williams, et al.<sup>17</sup> attempted to verify and extend the Shapiro and Yates findings. Their work confirmed the basic relationships given in Shapiro's laws with respect to the influence of the geometric properties of the stimulus. A slight but significant interaction was found between figure and ground wherein occurrence of rotation increased when figure and ground were incongruent. The extension of the Shapiro and Yates research centered around the investigation of 1) the effect of intelligence on

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17 Harold L. Williams, Ardie Lubin, Charles Giese-king, and Irvin Rubinstein, "The Relation of Brain Injury and Visual Perception to Block Design Rotation", Journal of Consulting Psychology, Vol. 20, No. 4, August 1956, p. 275-280.

the occurrence of the rotation phenomenon and 2) the effect of blocking peripheral vision in brain-damaged subjects. The results revealed negative correlations (-.38 to -.71) between intelligence and rotation. Brain-damaged subjects could not be differentiated from dull normal subjects on the basis of rotation scores. Under conditions of restricted peripheral vision, frequency of rotation increased in normal and decreased in brain-damaged subjects. It should be noted that according to Shapiro's reasoning, restricting peripheral vision in brain-damaged subjects should not affect the occurrence of rotation. Williams, et al. interpreted their findings as negating Shapiro's hypothesis that brain-damaged subjects rotate because they are unable to attend to peripheral cues which would assist in correct orientation. Instead, they held that the brain-damaged subject does react to peripheral cues but that these cues serve to distract and confuse the subject with respect to the visual frame of reference. Hence with restricted peripheral vision frequency of rotation would be expected to decrease in brain-damaged subjects.

A more recent study of block design rotation was reported in 1961 by Williams, et al.<sup>18</sup> This second study was designed with two main purposes in mind. The first aim was to study the effect of set on the occurrence of rotation. It was found that when rotation is called to the attention of non-brain-injured controls there was a greater decrease in rotation than occurred for brain-injured subjects operating under the same instructions. These findings were interpreted as indicating that in brain-damaged subjects rotation is a function of impaired perception rather than lack of attention.

The second aim was to replicate the previous finding that restricting peripheral vision decreased rotation in brain-injured subjects and increased occurrence of the phenomenon for dull normal and normal subjects. These findings were confirmed.

All of the previously reviewed research was concerned with the reproduction of the stimulus design by means of blocks. In 1956 Yates<sup>19</sup> reported a study which attempted to

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<sup>18</sup> Harold L. Williams, Charles F. Gieseking and Ardie Lubin, "Interaction of Brain Injury with Peripheral Vision and Set", Journal of Consulting Psychology, Vol. 25, No. 6, December 1961, p. 543-548.

<sup>19</sup> Aubrey J. Yates, "The Rotation of Drawings by Brain-Damaged Patients", Journal of Abnormal and Social Psychology, Vol. 53, No. 2, September 1956, p. 178-181.

determine whether Shapiro's laws, and some of the related findings, would hold in an analogous situation. Instead of reproducing the design with blocks the subject was requested to draw the design. The populations studied were female student nurses, non-brain-damaged psychiatric patients, and brain-damaged patients. Contrary to previous findings with the block version of the test, analysis of the data in the drawing version showed no significant effect of the angle of the line of symmetry. The figure shape was found to be the most significant factor influencing the occurrence of rotation, with the diamond-shaped figure eliciting the most rotation. With respect to ground, and in accord with Shapiro's laws, the diamond-shaped ground produced more rotation than the square-shaped ground. On the drawing version of the Block Design Rotation Test brain-damaged subjects again rotated significantly more than the other two groups. Actual discrimination between brain-damaged and non-brain-damaged subjects, however, is most satisfactorily accomplished when the subject reproduces the stimulus design with blocks rather than via drawings.

With respect to the present study, review of the literature dealing with the rotation of block designs has shown that varying the geometric properties of the stimulus does influence the occurrence of rotation. In addition the influence of these geometric properties has been shown to

operate in a lawful fashion as follows:

1. placement of the ground in a diamond orientation tends to increase rotation; whereas, square orientation tends to decrease rotation.
2. placement of the design in a diamond orientation tends to increase rotation; whereas, square orientation of the design tends to decrease rotation.
3. The influence of figure shape is greater than the influence of ground shape.

In the following section research centering around the relationship between certain stimulus variables and the occurrence of rotation in the reproduction of Bender-Gestalt configurations will be considered.

### 3. Rotation of Bender-Gestalt Configurations.

That the rotation or angular displacement of one or more Bender-Gestalt configurations is of diagnostic significance has been an accepted belief of clinicians for many years. This belief is rooted primarily in the frequency with which research, employing both children and adults as subjects, has shown rotation to be one of the factors which differentiate significantly between normals and various

clinical groups.<sup>20,21,22,23,24</sup>

Since the early 1950's a few attempts have been made to expand and clarify the existing information on the phenomenon of Bender-Gestalt rotation. These attempts have taken two main directions. Firstly, efforts have been made to provide information on the incidence of rotation in various clinical groups. Secondly are those studies which attempt to develop a theoretical rationale for the occurrence of the rotation phenomenon. These two phases of the existing research will be reviewed in turn, but it is with the latter studies that the present research is primarily concerned.

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20 Eugene Byrd, "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, June 1956, p. 127-136.

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

22 Aileen Glawson, "The Bender Visual-Motor Gestalt Test as an Index of Emotional Disturbance in Children", Journal of Projective Techniques, Vol. 23, No. 2, June 1959, p. 198-206.

23 Jerry B. Fuller and Gilles Chagnon, "Factors Influencing Rotation in the Bender-Gestalt Performance of Children", Journal of Projective Techniques, Vol. 26, No. 1, March 1962, p. 36-46.

24 Gerald B. Fuller and James T. Laird, "The Minnesota Percepto-Diagnostic Test", Special Monograph Supplement, Vol. 19, No. 1, of the Journal of Clinical Psychology, issue of, January 1963, p. 111 to 34.

In 1950 Hanvik and Anderson<sup>25</sup> published findings on the occurrence of rotation in a group of forty-four male adults suffering from focal brain lesions, and a group of thirty-seven controls. The latter group consisted of fourteen patients with a herniated intervertebral disc, and twenty-three patients in whom there existed a low back pain syndrome which was considered to be psychogenic in origin. Neurological and physical examinations of these twenty-three patients were reported as "essentially negative". The brain-damaged group was comprised of twenty-four patients with lesions in the "dominant" hemisphere. Brain-damaged and control groups were compared for the percent of cases in which one or more design had been rotated 30 degrees or more from the original plane. It was found that 59 percent of the total brain-damaged group produced one or more such rotations, whereas only 18.9 percent of the controls produced similar rotations. This difference between the control and experimental groups was found to be significant at the .001 level of confidence. Within the brain-damaged group there was no significant difference between the dominant-hemisphere group and the non-dominant-hemisphere group as to the percentage of cases rotating the figures. No specific data are

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<sup>25</sup> L. J. Hanvik and A. L. Anderson, "The Effect of Focal Brain Lesions on Recall and the Production of Rotations in the Bender-Gestalt Test", Journal of Consulting Psychology, Vol. 14, No. 3, June 1950, p. 197-198.

furnished on the frequency with which rotation occurred in the control sub-groups, i.e., "normals" and "neurotics". The authors comment, however, that rotation occurred in both of these groups but do not state whether there was a significant difference between the two groups.

Griffith and Taylor<sup>26</sup> later provided actuarial statistics on the frequency of rotation in additional clinical groups consisting of 346 schizophrenics, 167 neurotics, 165 character disorders, 147 chronic brain syndromes, and 59 mental defectives. A more stringent criterion for rotation was employed in that an angular displacement of 45 degrees or more from the original plane was required. The percentage of Bender-Gestalt protocols in each category containing one or more rotations was as follows: schizophrenics, 19.7; neurotics, 19.8; character disorders, 16.6; chronic brain syndrome, 40.85; and mental defectives, 55.9 percent. The chronic brain syndrome and mental deficiency groups differed from each other at the .05 probability level. Both of these groups produced a significantly higher, .01 level of confidence, incidence of rotation than did the schizophrenics, neurotics, and patients suffering from character disorders. No statistical comparison was made

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<sup>26</sup> Richard N. Griffith and Vivian H. Taylor, "Incidence of Bender-Gestalt Figure Rotations", Journal of Consulting Psychology, Vol. 24, No. 2, April 1960, p. 189-190.

between these three groups and Hanvik and Anderson's controls, but it would appear that the percentage of rotation is roughly comparable.

Subsequent research designed to throw additional light on the incidence of rotation in the Bender protocols of retarded individuals was conducted by Silverstein and Mohan.<sup>27</sup> Using the same criterion for rotation employed by Griffith and Taylor, the authors studied the records of 400 patients confined to a hospital for the mentally retarded. Their findings showed that 40 to 50 percent of the retardates produced one or more rotation. This finding was interpreted as being consistent with that of Griffith and Taylor.

Both the Griffith and Silverstein studies are subject to criticism in that each was a post hoc study in which the Bender protocols had been part of the battery employed in establishing the original diagnosis. The Silverstein study may have been further contaminated by the fact that some of the retardates showed evidence of organic pathology.

Data provided in all three of the reports reviewed were based on the protocols of hospitalized patients.

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<sup>27</sup> A. B. Silverstein and Philip F. Mohan, "Bender Gestalt Figure Rotations in the Mentally Retarded", Journal of Consulting Psychology, Vol. 26, No. 4, August 1962, p. 386-388.

Relative to non-patients, in their group of 260 adults, Pascal and Suttell<sup>28</sup> found rotation to occur once on Design 3 and once on Design 7, with no scorable rotations being obtained on the remaining configurations. Their criteria for scoring rotation vary for the different configurations but in no instance is a rotation of less than 45 degrees scored. The Pascal and Suttell findings would be consistent with those of Fuller and Laird<sup>29</sup>, to be discussed below, wherein none of the 280 "normals" studied rotated the configurations more than 30 degrees.

In light of the above mentioned findings relative to the incidence of rotation, research projects designed to establish a theoretical rationale for the occurrence of this phenomena will now be reviewed.

In 1958 Hannah<sup>30</sup> reported a study aimed at showing that Bender deviations could be attributed to factors other than mental pathology. Attention was focused on the rotation phenomenon. The author noted that on the standard Bender-Gestalt cards the design is printed on a card that is

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<sup>28</sup> Gerald R. Pascal and Barbara J. Suttell, The Bender-Gestalt Test. Quantification and Validity for Adults, Grune and Stratton, New York, 1951, p. 97-99.

<sup>29</sup> Fuller and Laird, Op. Cit., p. 16.

<sup>30</sup> Lewis D. Hannah, "Causative Factors in the Production of Rotations on the Bender-Gestalt Designs", Journal of Consulting Psychology, Vol. 22, No. 5, October 1958, p. 398-399.

horizontally oriented, i.e., where the horizontal dimension is longer than the vertical dimension. Contrary to this, the paper on which the subject is to draw has shorter horizontal than vertical edges. It was his contention that in order to preserve the orientation of the design on the card, it was necessary for the subject to rotate his drawing 90 degrees. A new set of cards was designed wherein the size of the stimulus design and the horizontal edge of the stimulus cards remained the same as in the original Bender-Gestalt test. The vertical edge of the new cards, however, was extended to make the ratio of the length of the horizontal edge of the card to its vertical edge the same as the ratio of the 8½ by 11 inch paper on which the subject drew. It was proposed that fewer rotations would be produced by the new stimulus cards.

Two groups of psychiatric patients, thirty-six subjects per group, were matched for age, sex and diagnosis. The experimental group was given the new stimulus cards and the control group the standard Bender cards. Rotation was scored for each design which was clearly rotated 45 or more degrees. Thus a score of eight was the maximum score possible for any one protocol. Statistical analysis showed that the two groups differed significantly at the .01 level of confidence. The average score per record for the experimental group was .222 degrees of rotation and .639 for the control

group. Each group produced eight records with rotations. The author concluded that the rotations were produced as a function of the way the stimulus design was oriented on the original Bender card.

Griffith and Taylor<sup>31</sup> attempted to replicate the Hannah findings, contending that the latter's statistically significant differences resulted from the fact that a few of his controls produced records with multiple rotations. Rather than redesign the stimulus cards, Griffith and Taylor attempted to achieve a "comparable" effect by rotating the paper tablet on which the subject drew. Thus the tablet was oriented lengthwise from left to right rather than up and down as in the Hannah study. Rotation was scored for an angular displacement of 45 or more degrees. Experimental and control groups were matched for diagnosis. Fifty-six subjects comprised the experimental, i.e., tablet-turned group, and 127 subjects the control group. In the experimental group 12.5 percent of the records had one or more figure rotations; while the control group produced 29.3 percent records with one or more rotation. Employing a one-tailed test these two proportions differed significantly at the .02 level of confidence. An additional 995 subjects were

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<sup>31</sup> Richard M. Griffith and Vivian H. Taylor, "Bender-Gestalt Figure Rotations: A Stimulus Factor", Journal of Consulting Psychology, Vol. 25, No. 1, February 1961, p. 89-90.

subsequently added to the control group making a total of 1,152 Bender protocols. The percent of records with one or more figure rotation was found to be 23.5, which differed at the .05 level of statistical significance from the 12.5 percent for records with rotation in the tablet-turned group. The authors regarded their results as confirmatory of the findings of Hannah and concluded "...that many rotations are caused by the patient orienting the design to the main axis of the paper in the same relation it bears to the major axis of the card..."<sup>32</sup>

Additional studies, dealing with factors influencing rotation, have been reported by Fuller and his co-workers. Fuller and Chagnon<sup>33</sup> proposed that rotation may be influenced by cue utilization, stimulus variation or a combination of cue utilization and stimulus variation. With respect to cue utilization the authors reasoned that emotional excitation, arousal, or disturbance tend to reduce the range of cue utilization. Lack of cue utilization may influence the rotation effect in that the emotionally disturbed, aroused, or excited individual is less able to draw on the cues necessary

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<sup>32</sup> Ibid., p. 89.

<sup>33</sup> Jerry B. Fuller and Gilles Chagnon, "Factors Influencing Rotation in the Bender-Gestalt Performance of Children", Journal of Projective Techniques, Vol. 26, No. 1, March 1962, p. 36-46.

to avoid rotation. Range of cue utilization was considered to be isotonic to the differences in degree of emotional disturbance of three groups of subjects. These groups consisted of normal, emotionally disturbed and schizophrenic children between the ages of eight and fifteen years.

Existing research had already indicated an apparent relationship between the axial orientation of both stimulus card and drawing paper, and the occurrence of rotation. Employing a total of thirty stimulus cards, Fuller and Chagnon attempted to further evaluate the influence of the properties of the stimulus card. The thirty cards were grouped into six "sets" of five cards with each "set" alphabetically identified. Each "set" contained one each of configurations A, 1, 2, 3, and 8 of the original Bender.<sup>34</sup> Two of the "sets", 'e' and 'f', employed a diamond shaped ground; two, 'd' and 'b', a vertically oriented rectangle; and two, 'a' and 'c', a horizontally oriented rectangle. Each pair of ground shapes was further sub-divided so that in each pair one "set" presented the stimulus configuration in a vertical position (sets 'f', 'b' and 'e') and the other presented the configuration in a horizontal (sets 'e', 'd' and 'a') position. Only set 'a' maintained consistency with

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<sup>34</sup> Fuller applies different numbers to all but Design 3. In this manuscript, however, consistency with the original Bender numbers has been maintained in presenting the Fuller findings.

the original Bender test. The remaining five "sets" each represented one or two modifications of the original stimulus cards. Two of the four rectangular "sets" embodied congruence between the orientation of the figure and the ground and two of these "sets" represented incongruence of figure and ground. Congruence, for the rectangular shape, existed if both the ground and the configuration were oriented vertically or horizontally. Incongruence existed where either figure or ground was vertically oriented and its counterpart horizontally oriented, or the reverse.

By means of analysis of variance the relative influence of the six "Sets", five "Configurations" and three "Groups" was evaluated. Rotation was scored for "any reproduction of a drawing which altered the actual axis of the drawing".<sup>35</sup> The primary findings were as follows: For "Groups", normal subjects differed significantly, .01 level of confidence, from both the emotionally disturbed and schizophrenic groups; and, the emotionally disturbed and schizophrenic groups also differed significantly from each other. The mean values for rotation for the three groups were 1.90 degrees of rotation for the normal group, 15.00 for the emotionally disturbed and 24.62 for the schizophrenic group.

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<sup>35</sup> Ibid., p. 40.

With respect to the five "Configurations", Bender Designs A and J elicited the most rotation, with mean values of 14.40 and 22.55 respectively. Only Design J, however, differed significantly from Designs I, H, and G. The least rotation, mean value of 8.50, was elicited by Design H.

Of the six "Sets", set 'a', which maintained the figure-ground relationships existent in the original Bender, differed significantly from all other "sets" except set 'b'. The latter set represented a 90 degree rotation of the original Bender cards. Sets 'a' and 'b' produced very little rotation in comparison with the remaining four sets. The latter, sets 'c', 'd', 'e' and 'f' did not differ significantly from each other. The authors concluded that each of these four sets contributed about the same amount of rotation and that it would have made little difference which of them had been included in the study. Significant double interactions were obtained for "Sets by Groups" and "Sets by Configurations."

Fuller interpreted these findings as supportive of the rationale that the greater the degree of emotional disturbance the less an individual is capable of counteracting rotation inducing properties of the stimulus because fewer cues are available to him. It was further concluded that the five designs studied differ with respect to their rotation inducing properties. The increased amount of rotation

elicited by Design 3 was explained in terms of the subjects dealing with separate units of the design, based on the principle of proximity of parts, and his difficulty integrating these parts into the larger unit. A possible relationship between rotation and the meaning of the design to the subject was also postulated. This arose as a possible explanation because some of the subjects envisioned Design 3 as being a Christmas tree and seemingly oriented their reproduction accordingly.

In the case of the six "sets" employed in the study, the authors concluded as follows:

...a vertically oriented figure produces more rotation than a horizontally oriented figure when the same ground shape is used as long as there is incongruency between figure and ground. When the ground shape was vertical and incongruent to the figure there was even more rotation produced. A diamond oriented ground produced more rotation than rectangular oriented ground regardless of the position of the figure. A diamond oriented ground when incongruent to the figure shape produced more rotation than when it was not.<sup>36</sup>

The authors interpreted their findings, with respect to stimulus variation, as supporting the rationale that more rotation will be produced by some figure-ground combinations than by others. They further concluded that both range of cue utilization and figure-ground orientation operate in eliciting

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<sup>36</sup> Ibid., p. 42-43.

rotation, and "...that certain combinations of figure-ground orientation and configurations were producing more rotation than others."<sup>37</sup>

Before proceeding to the final study in this review of the literature the writer would like to comment briefly about Fuller's findings on the variable of "sets". It will be noted that on this one dimension Fuller has incorporated three separate elements as follows: 1) ground shape, 2) orientation of the figure to the ground and 3) orientation of the ground. Thus, it is impossible, in the dimension of "sets", to separately evaluate the influence of each of these elements with respect to their rotation inducing powers. It is from this fact that the study reported in the present manuscript gains some of its value. The research to be outlined in the next chapter has been designed in such a way that the variables of figure shape, ground-shape and orientation of the figure to the ground can be separately studied.

In 1963 Fuller and Laird published the Minnesota Percepto-Diagnostic Test (MPD),<sup>38</sup> which had its origin in the research previously reported by Fuller and Chagnon. The

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<sup>37</sup> Ibid., p. 45.

<sup>38</sup> Gerald B. Fuller and James T. Laird, "The Minnesota Percepto-Diagnostic Test", Special Monograph Supplement, Vol. 19, No. 1, of the Journal of Clinical Psychology, issue of January 1963, p. III to 34.

purpose of the MFD was to provide a means of differentiating between various clinical groups on the basis of the degrees of rotation elicited by its six stimulus cards. The test was standardized on both children and adults. For purposes of the present review of the literature, however, only that aspect of the MFD which deals with adults will be reviewed.

The rationale for the MFD draws heavily on the principles of Gestalt psychology. In essence, the authors reason that rotation is a function of the stability or instability of the visual stimulus or gestalt. That is, the more stable the visual form the less the tendency toward rotation; and, the less stable the visual stimulus the greater the tendency toward rotation. Furthermore, the stability of visual form is in part a function of the degree of inhomogeneity between figure and ground and the interaction of figure and ground. In order for a visual form to have stability there must be inhomogeneity between figure and ground and congruence of figure and ground. Congruence exists when figure and ground have the same common fate. An example of such common fate would be a square-shaped figure on a horizontally oriented ground. The converse would be represented by a square-shaped figure on a diamond ground. The stability of the total gestalt is also influenced by the nature of the figure. Here consideration is given to the influence of the Gestalt Law of Prägnanz and the laws of the grouping. Stability of the

figure is increased as the degree of proximity or similarity, and the tendency toward a gute gestalt, are increased. Taking all of these factors into consideration, Fuller and Laird propose that "...there is a continuum ranging from cohesiveness and stability to ambiguity and instability for perceived figures."<sup>39</sup> The tendency toward rotation is decreased or increased by varying figure-ground relationships along this continuum.

The authors then set out to determine which figure-ground relationships were most rotated by brain damaged subjects, those least rotated by neurotics or psychotics, and those least rotated by normals. In this regard they state that

...through experimentation with figure and frames, one set of stimuli is perceived as ambiguous by the brain damaged and they produce greater degrees of rotation than the emotionally disturbed who perceive the stimuli as more cohesive than ambiguous, and when perceived by the normal the stimuli are primarily cohesive with only a few degrees of rotation.<sup>40</sup>

This set of stimuli comprises the six stimulus cards of the Minnesota Percepto-Diagnostic Test.

The MPD was standardized on a group of 540 adults of which 280 were classified as normals, 160 as suffering from a personality disturbance and 100 as chronic brain syndromes.

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<sup>39</sup> Ibid., p. 8.

<sup>40</sup> Ibid., p. 9.

The authors state that the test is most effectively used on adults ranging in age from 18 to 65 years with I.Q.s from 80 to 110. The coefficients of correlation between age and degrees of rotation, and education and degrees of rotation were low and not significant at the .01 level of confidence. In the normal group correlations of .40 and .41, significant at the .01 level, were obtained between intelligence and rotation.<sup>41</sup>

The rotation score is the actual number of degrees that the design was rotated from the vertical or horizontal axis of the stimulus card. This is true except where a design is rotated more than 25 degrees, in which case it is recorded as a 25 degree rotation. A score of 20 and below is considered to be normal; 21 to 59 indicative of a personality disturbance, and 60 and above to reflect organicity. A mean rotation score of 15.70 was obtained for the normal group. None of the normal subjects obtained a score exceeding 30 degrees. The test is considered to accurately identify 89 percent of the normals; 78 percent of the organics; and 60 percent of the subjects with a personality disturbance.<sup>42</sup>

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<sup>41</sup> The correlation between intelligence and rotation is discussed in more detail on pp. 36 and 37 of this manuscript.

<sup>42</sup> It should be noted that Fuller and Laird's "personality disturbance" group includes psychotics, neurotics and sociopaths.

With respect to reliability, upon retest 90 percent of the normals and organics remained in their original diagnostic category.

The work of Fuller and Laird represents a definite contribution in that it proposes and tests a specific theoretical rationale for the occurrence of the rotation phenomenon. Their findings are in accord with this rationale and point to the importance of both stimulus factors and factors within the individual as possible explanations for the occurrence of rotation. In addition the findings of Fuller and his co-workers highlight the meaningfulness of rotations of less than 45 degrees. The latter is one factor which previously had been relatively ignored in the interpretation and scoring of Bender-Gestalt protocols. It suggests that we might sharpen the accuracy of the Bender, as a diagnostic tool, by paying closer attention to minor deviations.

#### 4. Summary and General Hypothesis.

In summary, the review of the literature has briefly discussed the stimulus properties of visual forms and presented Gestalt propositions relative to the possible influence of these properties on the occurrence of rotation. Specific attention was subsequently given to research dealing with the occurrence of the rotation phenomenon in the reproduction of both block designs and Bender-Gestalt configurations.

The latter studies demonstrated that certain variations in the properties of the stimulus influence the subject's response and subsequently the occurrence of the rotation effect.

With respect to the rotation of block designs, the Shapiro studies revealed the following: 1) figure-shape is of greater influence than ground shape, 2) a diamond-shaped ground tends to increase rotation; a square-shaped ground tends to decrease rotation, and 3) a diamond-shaped design tends to increase rotation; a square-shaped design tends to decrease rotation.

Research dealing with Bender-Gestalt rotations highlighted the importance of congruence between figure and ground and the importance of the stability of the gestalt with respect to the Law of Prägnanz. That is, the greater the congruence between figure and ground and the more stable the gestalten, the less likely is rotation to occur.

The present study was designed for the purpose of verifying and extending existing knowledge as to the influence of stimulus variation on the occurrence of Bender-Gestalt rotation. Four ground shapes, three Bender figures, and three different orientations of figure to ground were systematically varied. Stated in the null form the general hypothesis is as follows: There are no significant differences among combinations of figure, ground and orientation with

respect to the degree of rotation produced. The second chapter of this report contains the experimental design employed in testing the specific hypotheses derived from this general hypothesis.

## CHAPTER II

### THE EXPERIMENTAL DESIGN

The purpose of this chapter is to present the procedures employed in testing the general hypothesis derived from the preceding review of the literature. Included in this portion of the report will be a description of 1) the subjects, 2) the instrument, 3) the testing and scoring procedures and 4) the statistical procedures used in testing the experimental hypotheses. The specific research hypotheses are formally stated at the conclusion of the second section.

#### 1. Subjects.

##### A. Criteria for Selection.

In the review of the literature, it was noted that occurrence of the rotation phenomena in the reproduction of Bender configurations, and also of the block designs, has been related to such non-stimulus variables as severe psychiatric disturbance and central nervous system pathology. Since the purpose of the present research was to study the effect of various stimulus properties on the occurrence of Bender rotations, the selection of subjects for this project was geared to eliminate or minimize the influence of these

related but non-stimulus variables. Therefore, it was necessary to secure as subjects a group of individuals in which the existence of neurological and/or severe psychiatric deficit was reasonably negated.

Further consideration had to be given to the possible relationship between intelligence and Bender-Gestalt rotation. A review of the literature failed to reveal any studies designed primarily for the purpose of specifically and systematically investigating such a possible relationship in adult subjects. The most directly pertinent findings are those obtained by Fuller and Laird<sup>1</sup> in their development and standardisation of the Minnesota Percepto-Diagnostic Test. Using 130 normal, adult subjects a correlation of .41, significant at the .01 level of confidence, was found for I. Q. and rotation. These subjects had a mean I. Q. of 110.7 as estimated by the Full Range Picture Vocabulary Test. The authors suggested, however, that the obtained correlation between rotation and intelligence could be an artifact due to the narrow I. Q. range for the normal group. It was

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<sup>1</sup> Gerald B. Fuller and James T. Laird, "The Minnesota Percepto-Diagnostic Test", Special Monograph Supplement, Vol. 19, No. 1, of the Journal of Clinical Psychology, issue of January 1963, p. iii to 34.

further contended that "it may be assumed that the higher the I. Q. in the normal group, the less rotation evidenced."<sup>2</sup> They did not find a significant correlation between intelligence and rotation in either the organic or personality disturbance groups.

It must be noted, however, that a recent study by Williams, et. al.,<sup>3</sup> on the rotation effect in the reproduction of block designs, indicates that intelligence may be a factor when dealing with subjects whose I. Q. is 85 or lower. While a possible relationship between the rotation of block designs and the rotation of Bender configurations has not been experimentally established, it seemed prudent in the design of this study to control for the possible influence of intelligence. Therefore, because of the uncertainty which exists as to the possible relationship between intelligence and rotation, it was decided to use as subjects only individuals with average or above average intelligence.

One additional qualification was required of the subjects, namely that they be right-handed. The decision to

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2 Ibid., p. 19.

3 Harold L. Williams, Ardie Lubin, Charles Giesecking, and Irvin Rubinstein, "The Relation of Brain Injury and Visual Perception to Block Design Rotation", Journal of Consulting Psychology, Vol. 20, No. 4, August 1956, p. 275-280.

include only right-handed subjects was based on Bender's<sup>4</sup> finding that in children arm movements are in a dextrad, clockwise direction in the right-handed subject, and in a sinistrad, counter-clockwise direction in left-handed subjects. Hence in an effort to provide uniformity with respect to the direction of rotation only right-handed subjects were included.

Therefore, three basic criteria were to be met by potential subjects. These criteria were as follows: 1) absence of both serious psychiatric disturbance and neurological deficit, 2) average or above intelligence and 3) right-handedness.

#### B. Implementation of the Selection Criteria.

A total of 238 young women were screened for participation in this study. These women were student nurses in their second and third years of training and were either on psychiatric affiliation at Toledo State Hospital or were preparing to enter said affiliation. All subjects were volunteers and as a group represented ten different nursing schools in the State of Ohio. None of the subjects had reached that part of their formal training which is designed

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<sup>4</sup> Laretta Bender, "A Visual Motor Gestalt Test and Its Clinical Use", American Orthopsychiatric Association, Research Monographs, No. 3, 1938, New York, p. 4.

to acquaint them directly with the nature and use of specific psychological techniques.

Evaluation of the possible existence of central nervous system pathology or psychiatric disorder was based on medical records provided by the home school and by the Nursing Education Department of Toledo State Hospital. An additional check was obtained by means of a personal interview with each volunteer.

Intellectual endowment was evaluated by means of the Shipley-Hartford Scale. This scale was selected because it is a quickly administered, objectively scored test which correlates .87 to .88 with the WAIS Verbal I. Q.<sup>5</sup> By means of the Wahler Conversion Method<sup>6</sup> it was possible to establish a cut off score of twenty-nine on the Shipley in order that only subjects with a converted I. Q. of 90 or above would be included in the present research.<sup>7</sup>

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5 H. J. Wahler and Luke S. Watson, "A Comparison of the Shipley-Hartford as a Power Test with the WAIS Verbal Scales", Journal of Consulting Psychology, Vol. 26, No. 1, February 1962, p. 105.

6 H. J. Wahler, Personal Correspondence with the Author of this Dissertation and an Extended Report of Footnote No. 5 of this Chapter, letter dated June 15, 1962.

See Appendix I of this report for a presentation of the Wahler Method.

7 A cut-off score of 29 with a corresponding I. Q. of 90 was employed. The mean I. Q. estimate for this study was found to be 110.26 with a range of 94 through 121 and a standard deviation of 3.934.

In order to obtain the 216 subjects required for this study a total of 238 young women were screened. One subject was eliminated because she was currently under psychiatric care, one reported an abnormal EEG, and one a history of skull fracture. Two additional subjects were eliminated, in one case because of an examiner error in administration of the experimental condition and in the second case because in reproducing the configuration the subject distorted the gestalt. The remaining seventeen subjects were eliminated because they were left-handed.

The 216 young women ultimately included in the study ranged in age from 18.67 years to 24.75 years with a mean age of 20.38 years.

## 2. Instrument.

Holding constant the variables of brightness, hue, size and location, the stimulus variables manipulated were those of figure-shape, ground-shape and orientation of the figure on the ground. Manipulation of these three variables resulted in the development of thirty-six stimulus cards which comprised the final test. The rationale for the selection of these thirty-six stimulus conditions is briefly outlined in the following paragraphs which conclude with a description of the final test.

### A. Figure Shape.

Figure-shape is specifically defined, for this research, in terms of the three designs which were selected from the nine original Bender configurations for use in this study. Selection of the configurations to be included was made on the basis of 1) the relative difficulty encountered in reproducing the designs and 2) the accuracy with which rotation could be scored.

In a study by Goodstein, et. al.,<sup>8</sup> the authors group the nine Bender configurations into three levels of difficulty. Designs A, 1, and 2 were found to be the easiest to reproduce; Designs 3, 4, and 7 the most difficult; and Designs 5, 6 and 8 to represent an intermediate level of difficulty. It was decided to select one design from each of these three groupings. Selection of the specific configuration to be included from each group was subsequently based on the accuracy with which rotation could be scored. With this criterion in mind Designs 1, 3, and 8 were selected. These configurations will be referred to by the same number allotted to them in the original Bender-Gestalt Test.

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<sup>8</sup> Leonard D. Goodstein, Charles D. Spielberger, John E. Williams and W. Grant Dahlstrom, "The Effects of Serial Position and Design Difficulty on Recall of the Bender-Gestalt Test Designs", Journal of Consulting Psychology, Vol. 19, No. 3, June 1955, p. 230-234.

Frequency with which a particular configuration elicits rotation was not taken into consideration in choosing the designs. While certain designs are more frequently rotated by children, as demonstrated by Goldberg<sup>9</sup> and Koppitz,<sup>10</sup> Pascall and Suttell's<sup>11</sup> research indicates that rotation is generally uncommon, according to their criteria, in an adult, non-patient population. Pascall and Suttell found rotation occurring once on Design 3 and once on Design 7 in a sample of 260 subjects. Scorable rotations were not obtained on any of the remaining six designs. Designs 1, 3, and 8 having been chosen, the next step was the selection of the ground-shapes.

#### B. Ground-Shape.

Ground-shape is herein defined in terms of the geometric properties of the white card on which the three Bender designs were to be printed. The diamond, square and rectangle were chosen in order to maintain an element of consistency

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<sup>9</sup> Franklin N. Goldberg, "The Performance of Schizophrenic, Retarded, and Normal Children on the Bender-Gestalt", American Journal of Mental Deficiency, Vol. 61, No. 3, January 1957, p. 548-555.

<sup>10</sup> Elisabeth M. Koppitz, "The Bender-Gestalt Test and Learning Disturbances in Young Children", Journal of Clinical Psychology, Vol. 14, No. 3, July 1958, p. 292-295.

<sup>11</sup> Pascall and Suttell, Op. Cit., p. 97-99.

between the ground-shapes employed here and those of existing related research on the rotation of block designs and Bender gestalten. It will be recalled that in the formulation of his laws for the BDRT Shapiro<sup>12</sup> makes reference to the relative influence of square and diamond orientation of the ground, stating that rotation tends to increase with diamond-shape orientation and to decrease with square-shape orientation. Fuller<sup>13,14</sup> on the other hand, studied the influence of the diamond ground as well as that of a vertically and horizontally oriented rectangle. It should be noted that the rectangular ground is also the ground-shape employed in the original Bender-Gestalt Test. A fourth ground-shape, that of the circle, was arbitrarily added because the review of the literature failed to reveal any studies which attempted to evaluate its influence on rotation.

The figure-shape and ground-shapes having been determined, the remaining step in the construction of the final

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12 M. B. Shapiro, "Experimental Studies of a Perceptual Anomaly: III. The Testing of an Explanatory Theory", Journal of Mental Science, Vol. 99, No. 416, July 1953, p. 394-409.

13 Jerry B. Fuller and Gilles Chagnon, "Factors Influencing Rotation in the Bender-Gestalt Performance of Children", Journal of Projective Techniques, Vol. 26, No. 1, March 1962, p. 36-46.

14 Gerald B. Fuller and James T. Laird, "The Minnesota Percepto-Diagnostic Test", Special Monograph Supplement, Vol. 19, No. 1, of the Journal of Clinical Psychology, issue of January 1963, p. iii to 34.

instrument dealt with the orientation of the figure on the ground.

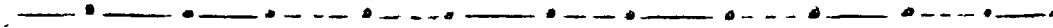
### C. Orientation of Figure on Ground

Orientation may be generally defined as the positional relationship of the main axis of the stimulus configuration (figure) to the horizontal axis of the ground on which it is presented. More specifically, orientation is the degree position of a fixed axis of each figure with reference to the horizontal axis of the ground. Figure 1 presents a pictorial representation of Configurations 1, 3, and 6, with a broken line indicating the fixed axis of each configuration as defined in this study.

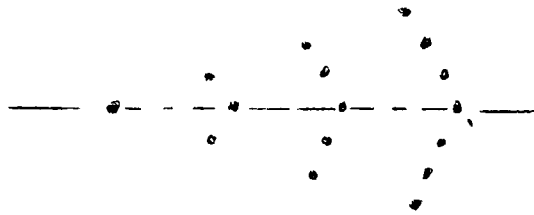
Three degree positions, i.e., orientations, were selected for use in this study, namely 0 degrees, 45 degrees,<sup>15</sup> and 90 degrees. Throughout this research these positions will be referred to respectively as horizontal orientation, oblique orientation and vertical orientation of the figure to the ground. As was true with the ground-shape, these three orientations were incorporated into this investigation for purposes of maintaining consistency with existing research.

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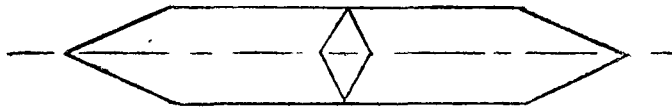
<sup>15</sup> For the 45 degree orientation, the fixed axis was positioned such that the upper end of the axis was to the subjects right and the lower end to the left.



Experimental Figure 1



Experimental Figure 3



Experimental Figure 8

Figure 1. Pictorial Representation of Figures 1, 3, and 8 with Broken Line Representing Horizontal Orientation of the Fixed Axis of Each Figure.

The three stimulus variables having been generally defined and subsequently specified, the following section of the report proceeds to a description of the final test.

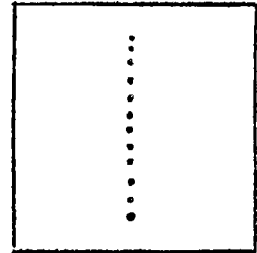
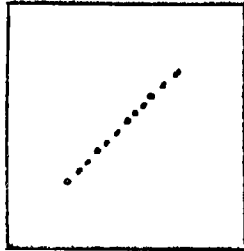
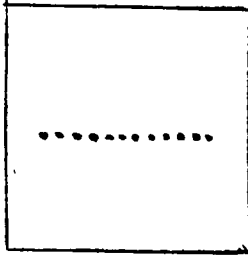
#### D. Summary Description of the Instrument.

The final test consisted of thirty-six white stimulus cards which represented all possible combinations of the three configurations, four grounds, and three orientations. The circular ground measured six inches in diameter, the square and diamond six inches on each side, and the rectangle six inches by nine inches. On each card, one of the three Bender configurations, in one of the three orientations (vertical, horizontal, oblique) was printed. Arbitrary grouping of the cards on the basis of ground-shape would result in four sets of cards with nine cards in each set. An example of the figure-orientation combinations for the square-shaped ground is contained in Figure 2. The same relationships hold for the three remaining ground-shapes.

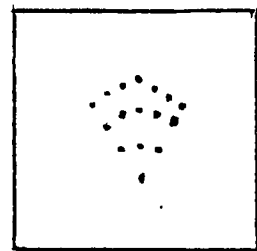
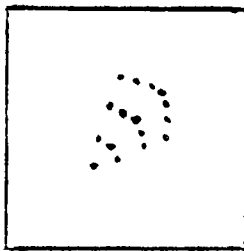
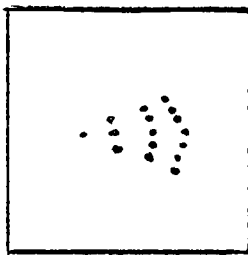
The exact nature of the stimulus conditions having been specified, the following section of the manuscript will present a statement of the specific research hypotheses.

#### E. The Specific Research Hypotheses.

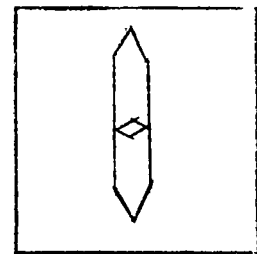
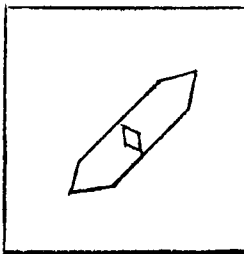
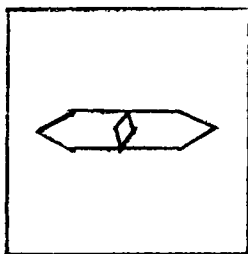
It has been postulated that rotation may be influenced by stimulus variation, i.e., by systematic manipulation of



Experimental Figure 1



Experimental Figure 3



Experimental Figure 8

Figure 2. Example of the Figure-Orientation Combinations for the Square-Shaped Ground

figure-ground-orientation relationships. Stated in the null form this general hypothesis is formulated as follows: There are no significant differences among combinations of figure, ground and orientation with respect to the degree of rotation produced.

For the sake of experimental verification the general hypothesis is broken down into the following specific hypotheses:

1. There is no significant difference between any two of the three figures for the degree of rotation produced.
2. There is no significant difference between any two of the four grounds for the degree of rotation produced.
3. There is no significant difference between any two of the three orientations for the degree of rotation produced.
4. There is no significant interaction between the three figures and four grounds for the degree of rotation produced.
5. There is no significant interaction between the three figures and three orientations for the degree of rotation produced.
6. There is no significant interaction between the four grounds and three orientations for the degree of rotation produced.
7. There is no significant interaction among the three figures, four grounds, and three orientations for the degree of rotation produced.

The specific procedures employed in testing these hypotheses will be presented in the next section of this report.

### 3. Testing and Scoring Procedures.

#### A. Procedure for Administration of the Test.

Prior to testing, a brief interview was conducted with each subject. This interview had a two-fold purpose in that it was designed to assist in the establishment of rapport, and secondly it provided the examiners with the opportunity of questioning the subject with respect to the existence of a history of head injuries, dizziness, fainting spells, headaches, convulsions, and psychiatric disturbance. If on the basis of this interview there was any reason to suspect the possibility of central nervous system pathology or severe psychiatric disturbance, the individual was eliminated from the study and replaced by another subject.

Six subjects were randomly assigned to each of the thirty-six stimulus conditions according to the method prescribed by Lindquist.<sup>16</sup> The decision to accept or reject a subject for inclusion in the study was made at the completion of the interview, immediately prior to testing. Subjects eliminated from participation were administered the stimulus condition to which they had been randomly assigned. The obtained protocol was then set aside and the same prescribed

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<sup>16</sup> E. F. Lindquist, Design and Analysis of Experiments in Psychology and Education, Boston, Houghton Mifflin, 1953, facing p. 385.

stimulus condition was administered to the next subject scheduled for testing. Each subject was individually tested.

Subsequent to the interview the subject was seated at a table the top of which measured thirty-seven inches in length and  $30\frac{1}{2}$  inches in width. The height of the table was  $26\frac{1}{2}$  inches. The table top consisted of a smooth piece of masonite which was finished with a flat black paint in order that directional cues would not be provided from the graining of the original surface. Consistent placement of the stimulus cards for each of the six subjects assigned to a specific figure-ground-orientation combination, was achieved by aligning each stimulus card with a set of dots placed on the table surface by means of a tiny pencil mark. These dots were perceptible to the examiner when in a standing position, but not visible to an individual who was sitting at the table.

Each subject drew her reproduction on a piece of  $8\frac{1}{2}$  by 11 inch white paper. The paper was attached to the table in a standard position by means of white photographer's corners. In each instance the stimulus card and the paper on which the subject was to draw had been placed in position before the subject entered the testing room. The stimulus was covered by a piece of cardboard during the period in which the subject was interviewed. Immediately after the interview, the subject was seated at the testing table and requested to close her eyes while the examiner removed the cardboard

covering from the test materials. Each subject was provided with two freshly sharpened No. 2 pencils. If a subject customarily wore glasses or wore them for reading purposes, she was instructed to do so while participating in the research. Upon removal of the concealing cover, the subject was given the following instructions:

"You see before you a card on which there is a design. You are to copy this design as well as you can. There is no time limit. You may erase if you wish—but you are not to move either the paper on which you draw or the card on which the design is printed. Remember you are to copy only the design that is printed on the card. Do you have any questions?"

If a question was raised by the subject, the instructions were first repeated verbatim. Any subsequent questions were non-committally answered by the statement, "You may do as you wish." or "Copy what you see." None of the subjects tested attempted to rotate either the stimulus card or the paper on which they drew.

Upon completion of this initial drawing the subject was taken into an adjoining room where the Shipley-Hartford Scale was administered. Placement of the Shipley at this stage of the testing procedure provided an interpolated activity between the initial drawing and the second drawing which was to follow.

Having completed the Shipley, the subject was returned to the initial testing room, again seated at the testing

table, and given the following instructions:

"Copy this design as well as you can. There is no time limit, you may erase. Copy only the design. Do not move the paper or the design."

Without being so instructed, the subject was asked to copy the same stimulus combination she had originally drawn. The purpose of this second drawing was to provide the examiner with an evaluation of the consistency with which the subjects as a group reproduced their configurations. Only the first drawing, however, was used in the actual statistical analysis of the data.

Two examiners participated in the collection of the data. Both examiners had been practicing clinicians for the previous 5½ to 6 years and both were familiar with the administration of the Bender-Gestalt technique. With respect to the use of two examiners, Pacella<sup>17</sup> reported no significant difference in the Bender protocols administered by two different examiners. It should be noted, that the Pacella study employed the Pascal and Suttell scoring system and not that used in the present research. Both scoring systems, however, are objective in nature.

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<sup>17</sup> Michael J. Pacella, "Inter-Examiner Effects on the Bender-Gestalt", Journal of Clinical Psychology, Vol. 18, No. 1, January 1962, p. 25.

The testing procedure having been described, the following section of this manuscript will present the method employed in scoring the obtained protocols.

#### B. Scoring Procedure.

For the purpose of this research rotation was defined as the smallest degree discrepancy between a fixed axis of the stimulus configuration and that of the reproduction, as measured by a TARGO n° 4485 adjustable angle scale.

It will be remembered that only right-handed subjects were included in this study. This decision had been made theoretically in an attempt to control for the direction of rotation. Further consideration of the problem led the author to conclude that this could be a faulty assumption since there was no means of determining whether the reproduction had been rotated in a clockwise or in a counter-clockwise direction. Hence, even in cases where rotation was obviously apparent to the naked eye, the question remained as to just how much rotation had taken place. In other words, what might first appear to have been a counter-clockwise rotation of 47 degrees could actually have been a clockwise rotation of 313 degrees. This problem had to be taken into consideration in developing a scoring procedure.

In order to surmount the problem of directionality, it was decided that in each case the smallest degree

discrepancy, regardless of direction, between the location of the fixed axis of the stimulus configuration and that of the reproduction would be considered the degree of rotation present. Employing this procedure the maximum rotation which could be scored was 90 degrees. This scoring method has the disadvantage of in some instances possibly minimizing the degree of rotation scored. On the other hand it provides the assurance that falsely elevated rotation scores could not be obtained.

Before continuing with a description of the scoring procedure, it is necessary to explain exactly what is meant by the terms "vertical axis", "horizontal axis" and "fixed axis". The horizontal axis is defined as any line which forms an angle of 0 degrees with the horizontal edge of the paper on which the subject drew. The vertical axis is any line which forms a 90 degree angle with the horizontal axis of said paper. While the terms "horizontal" and "vertical" axes apply mainly to the paper on which the drawing was reproduced, they may be extended to include the corresponding axes of the stimulus card (not design), and a sheet of graph paper which was used in the actual scoring.

In this manuscript the term "fixed axis" is applied only to the main axis of each of the Hender designs (configurations) as represented by the broken line in Figure 1. The "fixed axis" is related to the independent variable of

"Orientation". It will be recalled that with respect to orientation, the fixed axis of each design was varied on the stimulus card so as to assume oblique, horizontal and vertical positions. In the latter two cases the fixed axis of the configuration and the respective horizontal and vertical axes, defined above, would have the same geometric relationship.

Scoring of rotation was facilitated by use of a shadow box, the top surface of which consisted of a four-sided rectangular wooden frame fitted with a glass top measuring  $8\frac{1}{2}$  by 11 inches. The shadow box was wired so as to provide illumination, from a 100 watt electric bulb, through the underneath surface of the glass. In a stationary position on the glass surface was affixed a piece of graph paper over which the drawing to be scored was placed.

The graph paper was fastened to the shadow box in such a way that a constant relationship was maintained between its vertical and horizontal axes, those of the stimulus card (as presented to the subject), and those of the paper on which the subject drew. In other words, if these three, i. e., graph paper, stimulus card and drawing paper, were superimposed their respective horizontal and vertical axes would coincide. Thus, for purposes of scoring, the vertical and horizontal lines of the illuminated graph paper indirectly represented the vertical and horizontal axes of the original

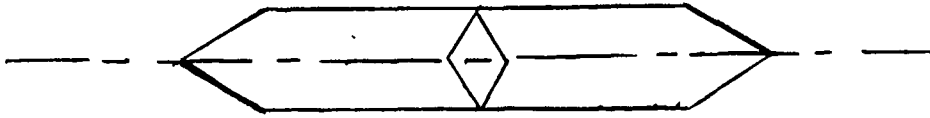
stimulus card and provided lines of reference for the scoring. Hence by properly placing the reproduction over the graph paper a direct measurement of the degree discrepancy between the fixed axis of the stimulus configuration and the fixed axis of the reproduced configuration could be taken.

Where there was no rotation the two fixed axes would be parallel, and if superimposed represented an angle of 0 degrees. When rotation was present the two fixed axes would intersect. By their intersection two angles were formed, measurement of which could be considered to represent the degree of rotation. Together these two angles represented a full 360 degree circle. Because the direction of rotation could not be specified, the degree measurement of the smaller of the two angles was recorded as the rotation score. Figure 3 gives an example of the two angles under consideration for a stimulus configuration that had been presented in an horizontal orientation. Example C of Figure 3 shows the angle scored in this research.

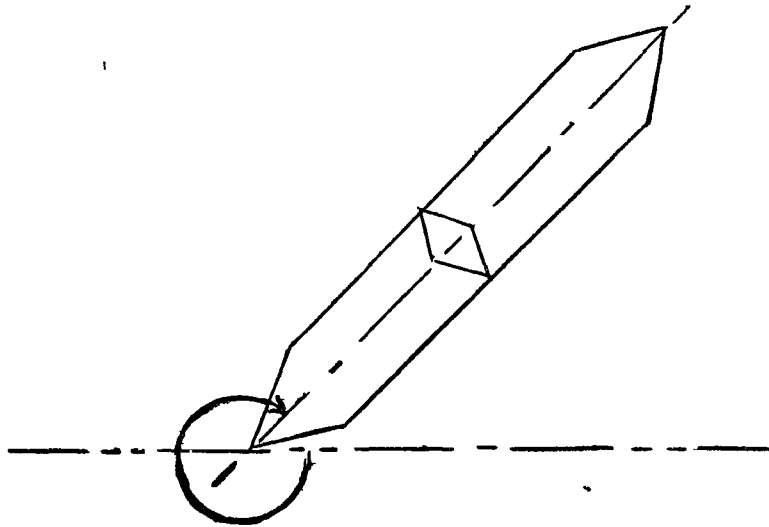
Measurement of the angles was made by means of the TARCO<sup>18</sup> adjustable angle scale which is calibrated in increments of 1° with additional 5° and 10° markings--on a full 0° to 180° scale. The TARCO consists of two scales, each

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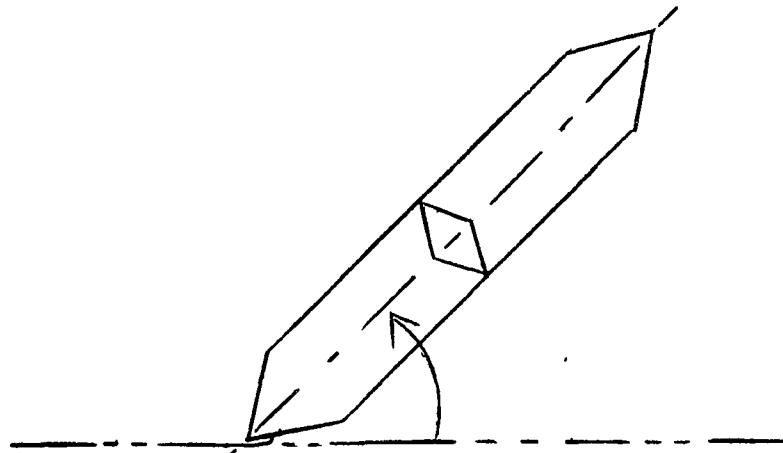
<sup>18</sup> The TARCO scale may be purchased from the Tarco Sales Corporation, 150 Green Street, Brooklyn 22, New York.



A. Horizontal Orientation of Original Stimulus



B. Clockwise Rotation of the Stimulus



C. Counter-clockwise Rotation of the Stimulus

Figure 3. Examples of the Two Angles which  
Could be Scored for Rotation  
Depending on Direction of  
Rotation Considered.

twelve inches long and divided into  $1/8$  inch and  $1/4$  inch sections. The two arms of the scale open into a full  $180^\circ$  arc. A clear plastic window permits reading of the measured angle.

By aligning one arm of the measuring instrument with the fixed axis of the reproduction and the other with an appropriate reference line on the graph paper, representing the fixed axis of the stimulus configuration, the proper angle could be measured. If the stimulus configuration was presented with the fixed axis in a horizontal orientation, the horizontal axes of the graph paper were considered the appropriate lines of reference; when presented in a vertical orientation the vertical lines of the graph paper were used. This procedure had to be amended slightly when the fixed axis of the stimulus configuration formed a  $45$  degree angle (oblique orientation) with the horizontal. For the oblique orientation, the horizontal axis of the graph paper was still used as the reference line. If the measured angle was greater than  $45$  degrees,  $45$  degrees were subtracted and the resultant rotation score recorded. Where the measured angle was less than  $45$  degrees, the rotation score was obtained by subtracting the obtained measurement from  $45$  degrees.

Prior to the actual statistical analysis of the resulting data, Pearson product moment correlations were run to check the reliability of the subjects' performance and of the

scoring. Subject reliability, based on the comparison of the rotation scores for their first and second reproduction of the same stimulus, was determined to be .749 with the standard error of the coefficient of correlation being .068. An N of 216 was used to compute this correlation. To compute the scorer's reliability thirty-six reproductions were re-scored, with an approximate two week interval between first and second scoring. A coefficient of correlation of .998 with a standard error of .167 was obtained. The standard error of measurement of the TARCO scale was not obtained. The high reliability of the scoring, however, suggests that any error inherent in the TARCO scale was a constant rather than variable error. As such it can be assumed that any error in the measuring instrument equally influenced all of the scores.

#### 4. Statistical Procedures.

This experiment was designed to determine the effect and/or interaction of figure, ground, and orientation (the independent variables) on rotation (the dependent variable). Analysis of the resulting data was best facilitated by a three-way analysis of variance patterned after McNemar's<sup>19</sup>

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<sup>19</sup> Quinn McNemar, Psychological Statistics, Second Edition, New York, Wiley, 1955, p. 328-329.

"Case X". This is a fixed constants model (ADG), in this case with six different individuals in each of the thirty-six cubicles. In "Case X" the estimate for the within variances ( $s^2_w$ ) is regarded as the proper error term for testing each of the three main effects, the three 2-way interactions, and the 3-way interaction. In this model generalizations are limited specifically to the three configurations, four grounds, and three orientations employed in the study. Generalizations can not be extended beyond this to include other figures, grounds and orientations. For purposes of this research, a level of significance of  $P \geq .05$  was the criterion chosen for evaluating the significance of an obtained F value.

Since analysis of variance is an overall test of significance, an F value which was found to be significant at, or beyond, the .05 level of confidence was further analyzed by means of 't'-tests. Here the purpose was to determine the significance of the differences between the means for a specific main effect, or double interaction, or for the triple interaction. The formula used for the 't'-test was: Significant Difference  $\geq t(p=.05) \times \sqrt{\text{Diff.}}$ .

The  $\sigma_{Diff.}$  was obtained by means of the following formula:

$$\sigma_{Diff.} = \sqrt{\frac{2\sigma^2}{n}}$$

In this formula  $\sigma^2$  refers to the within cubicle variance ( $s^2_w$ ) and  $n$  represents the  $n$  for any specific orientation, ground or figure. Thus the  $n$  for both Configurations and for Orientations is seventy-two and the  $n$  for Grounds is fifty-four. The values for  $t(P= .05)$ ,  $t(P= .01)$  and  $t(P= .001)$  were read from the table of 't' values for 175 degrees of freedom.<sup>20</sup>

The statistical procedures for analysis of the data having been outlined, the next chapter contains the presentation and discussion of the results.

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<sup>20</sup> The less stringent criterion of 180 df, the actual df equal to that of the error term, could have been employed. In order to avoid errors in interpolation from available t-test Tables, however, the more rigid criterion of 175 df was used.

## CHAPTER III

### PRESENTATION AND DISCUSSION OF THE RESULTS

This chapter will present the results of the statistical analysis of the data derived from this experiment, followed by a discussion of the obtained results.

#### 1. Results of the Experiment.

##### A. Analysis of Data for Main Effects: Figures, Grounds and Orientations.

The statistical approach employed in the study has been previously described in Section 4 of Chapter II of this manuscript. A summary of the resulting analysis of variance is given in Table I. This table reveals that for the three main effects of "Figures", "Grounds" and "Orientations" only two significant *F*-tests were obtained. The *F* for "Figures" was significant at the .05 level of confidence and the *F* for "Orientations" was found to be significant at the .001 level of confidence. Thus for the variables of figure-shape and orientation the null hypothesis can be rejected. It can be stated that within the conditions inherent in this study, variations in figure-shape and variations in orientation of the figure to the ground did differentially affect the occurrence of rotation. The *F*-test for "Grounds" was not significant and the null hypothesis cannot be rejected.

Table I.-

Summary of Analysis of Variance of the  
4 x 3 x 3 Fixed Constants Model.<sup>a</sup>

Source of Variation	SS	df	Estimate of Variance	F	P.05	P.01	P.001
F (Figure)	1159.09	2	579.55	3.09	<u>2.99</u> <sup>b</sup>	4.60	6.91
G (Ground)	205.79	3	68.60	.37	2.60	3.78	5.42
O (Orientation)	3942.53	2	1971.27	10.50	2.99	4.60	<u>6.91</u>
F x G	1100.25	6	183.38	.98	2.09	2.80	3.79
F x O	1189.72	4	297.43	1.58	2.37	3.32	4.62
O x G	1075.81	6	179.30	.95	2.09	2.80	3.74
O x G x F	2215.94	12	184.66	.98	1.75	2.18	2.74
Within-cubicle	33799.83	180	187.78				

<sup>a</sup> Quinn McNemar, Psychological Statistics, Second Edition, New York, Wiley, 1955, p. 328-330, (Case X).

<sup>b</sup> Underlined numbers represent significance at the specified level of confidence.

Because the analysis of variance is an overall test of significance, the results for both "Figures" and "Orientations" had to be further analyzed by means of 't'-tests to determine the significance of the difference between the means for the main effect "Figures" and for the main effect "Orientations".

For 175 degrees of freedom, 't' at the .05 level of confidence is 1.974, and at the .01 level of confidence 2.605. Substituting in the formula for  $\sigma_{\text{Diff}}$ , given on page 60 of this manuscript,  $\sigma_{\text{Diff}}$  for both "Figures" and "Orientations" equals 2.284. Thus a significant difference  $\geq 1.974 \times 2.284$  or 4.51 at the .05 level of confidence; and,  $2.605 \times 2.284$  or 5.95 at the .01 level of confidence was required.

Table II presents the results of the 't'-tests for the significance of the differences between the means of rotation scores for "Figures". It will be noted from Table II that Design 3 differed significantly from Design 8, at the .05 level of confidence, with Design 3 producing the most (mean value of 8.86) rotation and Design 8 producing the least (mean value of 3.29) rotation. No significant difference was found when Designs 1 and 3 or Designs 1 and 8 were compared for mean rotation scores.

The results of the 't'-tests used to determine the significance of the difference between the means of rotation scores for the three "Orientations" are contained in Table III.

Table II.-

Evaluation of the Difference of Means on the Rotation Scores of the Three Figures by Means of the t-Test.

Figures	Mean Values Compared	Difference	Significant Difference <sup>a</sup>	
			.05	.01
1-3	6.75-8.86	2.11	No	No
1-8	6.75-3.29	3.46	No	No
3-8	8.86-3.29	5.57	Yes	No

<sup>a</sup>  $t(p=.05)$ , significant difference  $\geq$  about 4.51  
 $t(p=.01)$ , significant difference  $\geq$  about 5.95.

Table III.-

Evaluation of the Difference of Means on the Rotation Scores of the Three Orientations by Means of the t-Test.

Orientations	Mean Values Compared	Difference	Significant Difference <sup>a</sup>		
			.05	.01	.001
V-H	3.25- 3.35	.10	No	No	No
V-G	3.25-12.31	9.06	Yes	Yes	Yes
H-G	3.35-12.31	8.96	Yes	Yes	Yes

<sup>a</sup>  $t(p=.05)$ , significant difference  $\geq$  about 4.51  
 $t(p=.01)$ , significant difference  $\geq$  about 5.95  
 $t(p=.001)$ , significant difference (when  $df=120$ )  $\geq$  about 7.70.

Here it can be seen that the oblique orientation differed significantly at the .001 level of confidence from both the horizontal and vertical orientations and elicited the most (12.31 degrees) rotation. No significant difference was obtained when the mean rotation scores for the vertical and horizontal orientations were compared. Thus either of these two orientations could have been included in this study to the exclusion of the other.

#### B. Analysis of the Data for First and Second Order Interactions.

Referring again to Table I it can be seen that none of the F-tests for the three first order interactions were found to be significant. Likewise, the F-test for the second order interaction failed to reach significance. Thus for each of these four interactions the null hypothesis cannot be rejected.

The results of the experiment having been presented, the following section of this report will proceed with a discussion of these findings. The raw data for this experiment are contained in Appendix II of this manuscript.

## 2. Discussion of the Results.

It had been hypothesized that variations in figure-shape, ground shape and orientation of the figure to the

ground, or any combination of two or more of the above factors would differentially affect the occurrence of rotation. In the presentation of the results, it was shown that variations in figure-shape and in orientation of the figure to the ground did significantly affect the degree of rotation manifested in the subject's reproduction. The four ground shapes did not differ significantly with respect to the amount of rotation they elicited. None of the three first order interactions, i. e., the interaction between figure and ground, figure and orientation, and ground and orientation was significant. Likewise, the second order interaction of figure by ground by orientation did not reach the required level of significance.

The results show several consistencies with those of previous research on the rotation of block designs and Bender-Gestalt configurations. The discussion of the findings will be directed toward drawing out these consistencies, and toward the presentation of additional possible interpretations of the results. Results for each of the three main effects will be separately discussed and will be followed by a few brief statements relative to the findings for the first and second order interactions.

**A. Discussion of Results for Main Effects: Figures.**

It will be recalled that Design 3 produced a mean rotation score of 8.65 degrees and Design 8 a mean score of 3.29 degrees rotation. These two means differed significantly at the .05 level of confidence. Design 1 (6.75 degrees) did not differ significantly from either Design 8 or Design 3 with respect to mean rotation score. The findings, with respect to Design 3 eliciting the most rotation, are basically consistent with those of previous research.

Using a criterion of 45 degrees for a scorable rotation, Goldberg<sup>1</sup> studied the Bender protocols of schizophrenic, normal, and retarded children. In each of these three groups, Design 3 produced the highest percentage of rotation. The only exception was in the normal group, wherein Design 5 elicited the same percentage as did Design 3. Similar findings on retardates were observed by Silverstein and Mohan.<sup>2</sup> Neither Goldberg nor Silverstein offered an explanation for their results. To this writer's knowledge, the first attempt

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1 Franklin H. Goldberg, "The Performance of Schizophrenic, Retarded, and Normal Children on the Bender-Gestalt", American Journal of Mental Deficiency, Vol. 61, No. 3, January 1957, p. 548-555.

2 A. B. Silverstein and Philip Mohan, "Bender-Gestalt Figure Rotations in the Mentally Retarded", Journal of Consulting Psychology, Vol. 26, No. 4, August 1962, p. 386-388.

to explain the rotation of Design 3 was made by Fuller and Chagnon.

The five gestalten studied by Fuller and Chagnon<sup>3</sup> included the three designs under consideration in the present research. Design 3 was again found to elicit the most (22.55 degrees) rotation. In their study, however, Design 3 differed significantly, at the .01 level of confidence, from both Design 1 and Design 8. These findings were considered by Fuller and Chagnon to be supportive of the rationale that the various Bender configurations are not equivalent items and thus contribute differentially to the amount of rotation produced. They interpreted their findings in terms of the Gestalt principle of proximity of parts, on which Design 3 is based. The authors postulated that "the subject might have trouble encompassing the total configuration and instead deals with the separate units which are segregated and yet at the same time belong to a larger unit."<sup>4</sup>

The present writer regards Fuller and Chagnon's explanation of the rotation of Design 3 in terms of the principle of proximity of parts as meaningful and in accord with

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<sup>3</sup> Jerry B. Fuller and Gilles Chagnon, "Factors Influencing Rotation of the Bender-Gestalt Performance of Children", Journal of Projective Techniques, Vol. 26, No. 1, March 1962, p. 36-46.

<sup>4</sup> Ibid., p. 42.

the Gestalt propositions outlined by Bender<sup>5</sup> in her original monograph. It will be recalled that according to Bender, both Design 1 and Design 3 are based on the same principle. It is also noteworthy, however, that in Design 1 the influence of proximity of parts is primarily based on the subject's perceiving the dots as paired, and that in adult subjects only about one-third perceive this pairing. Thus, the influence of the principle of proximity of parts may not be as great for Design 1 as for Design 3. Design 8, on the other hand, is theoretically based on the principle of continuity of geometrical or internal organization and is rarely seen as being comprised of separate units. The present writer suggests that segregation of Design 3 into separate units results in instability of the figure and increases its tendency to rotation. Separation of Design 1 and 8 into component parts is less common, and hence these figures are seen as more stable and less prone to rotation inducing tendencies.

Fuller and Chagnon also related the rotation of Bender configurations to varying levels of difficulty encountered in the simple reproduction of the gestalten.

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<sup>5</sup> Lauretta Bender, "A Visual Motor Gestalt Test and Its Clinical Use", American Orthopsychiatric Association, Research Monographs, No. 3, 1938, New York, p. 4-5.

Reference was made to Bender's<sup>6</sup> findings that Design 3 is the most difficult to produce and is not completely mastered until the eleventh year. Explanation of the rotation of this design on the basis of difficulty in reproduction, however, did not seem plausible for the current adult population. This statement is based on Bender's finding that "Adults add only a certain motor perfection or perfection in detail in sizes and distances."<sup>7</sup> Other explanations for the rotation of Design 3 by the population currently studied were sought.

It was felt that one such explanation could rest in the possible meaning of the design to the subject. With this idea in mind, existing research relative to the associative meaning of the designs was subsequently reviewed. Research in this area was found to be limited. Two pertinent studies by Tolor, however, were forthcoming.

In 1957, Tolor<sup>8</sup> studied a sample of fifty neuropsychiatric patients. The results showed that a quality of free, unimpeded movement was ascribed by twenty-four percent of the subjects to Design 3. Only two percent made this association to Design 1, and none of the subjects ascribed

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6 Ibid., p. 133.

7 Ibid., p. 112.

8 A. Tolor, "Structural Properties of the Bender-Gestalt Test Associations", Journal of Clinical Psychology, Vol. 13, No. 2, April 1957, p. 176-178.

it to Design 8. A companion study<sup>9</sup> employing the Semantic Differential was subsequently conducted on a group of sixty-eight college students. After the elimination of associations assigned in common to both Design 8 and Design 3, the following associations remained: Design 8 was considered "tasty", "valuable", and "peaceful". Design 3, on the other hand, was viewed as "active", "fast", and "light".<sup>10</sup>

Thus in both of the Tolor studies a quality of movement was associated with Design 3 and not with Design 8. The present writer suggests that the quality of movement associated with Design 3 in some way acts upon the subject and inclines him to rotate his reproduction; and, that subjects are less inclined to rotate Design 8 because movement is not associated with this particular design. The present statistical analysis does not permit generalization to gestalten other than those included in the current experiment. Extension and verification of this explanatory hypothesis is contingent upon the findings of additional research.

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9 A. Tolor, "The 'Meaning' of Bender-Gestalt Test Designs: A Study in the Use of the Semantic Differential", Journal of Projective Techniques, Vol. 24, No. 4, December 1960, p. 433-438.

10 Although Design 1 did not differ significantly from Design 3, it is noteworthy that the words "active" and "fast" were not associated with Design 1, and that this Design produced less rotation than did Design 3.

In review, the analysis of the data for the main effect of figure variation has shown that the three designs are not equivalent items and as such differentially affect the occurrence of rotation. The increased rotation elicited by Design 3 was explained in terms of the Gestalt principle of proximity of parts and the associative meaning of the design to the subject. It was suggested that these two factors lessen the stability of the figure and increase its tendency to rotation.

B. Discussion of Results for Main Effects: Grounds.

The F-test for the main effect of "Grounds" was not significant; hence, within the frame-work of this study, variations in ground shape did not differentially affect the occurrence of rotation. It can be concluded that it would have made little difference which of the four ground shapes had been included in this study.

C. Discussion of Results for Main Effects: Orientations.

It will be recalled that the F-test for "Orientations" was significant. Thus the null hypothesis was rejected, and it can be stated that the three variations of orientation of the figure to the ground did differentially affect the degree of rotation elicited. Subsequent t-tests revealed that oblique orientation of the stimulus design resulted in

significantly (.001 level of confidence) more rotation than did either the vertical or horizontal orientations. When the mean rotation scores for the vertical and horizontal orientations were compared to each other, there was no significant difference.

It is difficult to relate these findings to those of Fuller and Chagnon<sup>11</sup> because the latter took into consideration only the vertical and horizontal orientations. Secondly, in their main effect of "Sets", these two orientations were considered jointly with variations in ground shape. The authors do note, however, that in those "sets" where the same ground shape was employed, more rotation was elicited by vertically oriented than by horizontally oriented figures. This relationship held for Fuller and Chagnon as long as there was incongruence between figure and ground.

The study being reported in this manuscript did not show a significant difference between mean rotation scores for the vertical and horizontal orientations. As subsequent discussion will show, however, the findings do support the importance of incongruence between figure and ground as a factor in the occurrence of rotation. Before proceeding further with this discussion, it is first necessary to more closely examine the geometric properties of the three designs

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<sup>11</sup> Fuller and Chagnon, Op. Cit., p. 36-46.

included in the present research.

Figure 4 shows each of the three designs and their fixed axis, illustrated by broken line "A". For Designs 3 and 8 it can be seen that the fixed axis cuts the design into mirror images. This effect is less immediately apparent for Design 1, yet actually the fixed axis may be regarded as dividing that stimulus figure into two parallel lines of twelve filled-in semicircles.

It is proposed that the "fixed axis" of the stimulus design, as defined in the present research, is comparable to the "line of symmetry" referred to by Shapiro;<sup>12</sup> and, that its influence on the occurrence of Bender-Gestalt rotation is similar to the influence of the line of symmetry on the rotation of block designs.

It will be recalled that in his first law Shapiro states as follows:

When the line of symmetry is at an angle to the vertical axis of the total visual field...the tendency to rotate will be increased. When the line of symmetry is parallel to the vertical axis of the visual field, then the tendency to rotate will be lessened.<sup>13</sup>

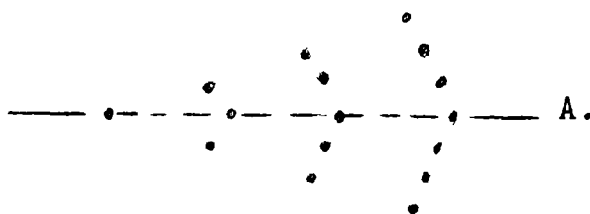
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<sup>12</sup> M. B. Shapiro, "Experimental Studies of a Perceptual Anomaly: III. The Testing of an Explanatory Theory", Journal of Mental Science, Vol. 99, No. 416, July 1953, p. 394-409.

<sup>13</sup> Shapiro, Ibid., p. 395.



Experimental Figure 1



Experimental Figure 3



Experimental Figure 8

Figure 4. Lines of Symmetry in Designs 1, 3 and 8.

When the fixed axis of stimulus Designs 1, 3, and 8 is viewed as a line of symmetry, the findings of the present research are basically in accord with Shapiro's first law. Oblique orientation of the stimulus designs always resulted in the fixed axis being at an angle to the vertical axis of the visual field. For the oblique orientation, the results showed a significant increase in rotation over both the horizontal and vertical orientation. It is suggested that for the oblique orientation rotation arises out of an attempt to achieve congruence between the fixed axis of the stimulus and the vertical axis of the visual field. It should be noted, however, that according to this reasoning a significant difference would have been expected between the horizontal and vertical orientations, since in the horizontal orientation the fixed axis is at a 90 degree angle to the vertical axis of the visual field.

The significant difference obtained between the horizontal and oblique orientations is in accord with the findings of Goldstein and Scheerer.<sup>14</sup> They hypothesized that position on a horizontal base is more natural and more concrete than an angular position and thus produces more rotation.

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<sup>14</sup> Kurt Goldstein and Martin Scheerer, "Abstract and Concrete Behavior: An Experimental Study with Special Tests", in the Psychological Monographs, Vol. 53, No. 2, Whole No. 239, 1941, p. 32-57.

Thus the findings of the present study, with respect to orientation, are considered to be in accord with the Law of Prägnanz which states that configurations tend to become as 'good', precise, and impressive as possible; and, that in so doing they change toward a more uniform, level state in which differences tend to be obliterated. This writer proposes that in the oblique orientation the difference which the subject tends to obliterate through rotation is the incongruence that exists between the fixed-axis (line of symmetry) of the stimulus design and either the vertical or horizontal axis of the visual field.

The next portion of the report will discuss the findings for the first and second order interactions.

#### D. Discussion of the Results for First and Second Order Interactions.

The F-tests for the double interactions of figures by grounds, figures by orientations, and orientations by grounds were not found to be significant. In each case the null hypothesis could not be rejected. Thus there was no specific combination of a particular figure with a particular ground, or with a particular orientation, that elicited significantly more rotation than any other such combination. Secondly, no single orientation when combined with any one of the four ground shapes significantly affected the occurrence

of rotation. Since the F-tests for the main effect of "Figures" and for the main effect of "Orientations" had reached significance, it might have been expected that the double interaction of these two main effects would also be significant.

The second order interaction of figures by grounds by orientations also failed to reach significance when the F-test was applied. The null hypothesis could not be rejected. Thus it is concluded that there was no instance in which a combination of any one of the three figures, with one of the four grounds, in any one of the three orientations which produced significantly more rotation than any other such possible combination.

The results of this experiment having been discussed, the final section of this report will present a summary of the experiment, a statement of its conclusions, and suggestions for future research. The statement of the conclusions will be formulated in terms of a proposed rationale for the occurrence of rotation.

## SUMMARY AND CONCLUSIONS

The present research was designed for the purpose of verifying and extending existing knowledge as to the influence of stimulus variation on the occurrence of Bender-Gestalt rotation. The three stimulus variables under consideration were those of figure-shape, ground-shape and orientation of figure to the ground. The effect of varying these three stimulus properties was studied in an adult, non-patient population consisting of 216 female student nurses between the ages of eighteen and twenty-five years and of average or above intelligence.

On the basis of a review of the literature as to the stimulus properties of visual forms and the rotation of both block designs and Bender-Gestalt configurations a general hypothesis, stated in the null form, was formulated as follows: There are no significant differences among combinations of figure, ground and orientation with respect to the degree of rotation produced.

Three Bender figures, four ground-shapes, and three different orientations of figure to ground were systematically varied. Manipulation of the three variables resulted in the development of thirty-six stimulus cards. These thirty-six cards represented all possible combinations of Bender Designs 1, 3, and 8, when individually presented on a

circular, square-shaped, diamond-shaped or rectangular ground in either a vertical, a horizontal, or an oblique orientation. The specific hypotheses to be tested, when stated in the null form, read:

1. There is no significant difference between any two of the three figures for the degree of rotation produced.
2. There is no significant difference between any two of the four grounds for the degree of rotation produced.
3. There is no significant difference between any two of the three orientations for the degree of rotation produced.
4. There is no significant interaction between the three figures and four grounds for the degree of rotation produced.
5. There is no significant interaction between the three figures and three orientations for the degree of rotation produced.
6. There is no significant interaction between the four grounds and three orientations for the degree of rotation produced.
7. There is no significant interaction among the three figures, four grounds, and three orientations for the degree of rotation produced.

Rotation was defined as the smallest degree discrepancy between a fixed axis of the stimulus configuration and that of the reproduction, as measured by a TARCO n° 4485 adjustable angle scale. Analysis of the resulting data was accomplished by means of a 3-way analysis of variance, fixed constants model.

Results of this analysis for the three main effects, the three first interactions, and the double interaction were as follows: Research hypotheses 1 and 3 were rejected. The five remaining hypotheses could not be rejected.

With respect to the first hypothesis, the results showed that Design 3 produced the most rotation and differed significantly from Design 8, but not from Design 1, as to mean rotation score. No significant difference was found between the mean rotation scores for Design 1 and for Design 8. These results verify previous findings 1) that Designs 3 and 8 are not equivalent items and that they differentially affect the occurrence of rotation and 2) that Design 3 tends to produce the most rotation. The increased rotation elicited by Design 3 was attributed to the influence of the Gestalt principle of proximity of parts. It was reasoned that rotation results when the subject encounters difficulty grasping the total configuration and deals instead with the segregated units comprising the whole. A second possible explanation for the rotation of Design 3 was offered in terms of the quality of movement associated with this particular design. It was hypothesized that this quality of movement in some way acts upon the subject and inclines him to rotate his reproduction. Conversely, it was reasoned that subjects are less inclined to rotate Design 8 because movement is not associated with this particular design. Both difficulty grasping the

total configuration and the quality of movement associated with Design 3, are viewed as lessening its stability.

With respect to the third hypothesis, the statistical analysis revealed that oblique orientation of figure to ground resulted in significantly more rotation than either vertical or horizontal orientation. Statistical comparison of the mean rotation scores for the vertical and horizontal orientations failed to show a significant difference. These findings were related to those of Shapiro on the rotation of block designs. It was postulated that the fixed axis of the stimulus design was comparable to a line of symmetry and accordingly influenced rotation. Incongruence between the fixed axis of the stimulus design and either the vertical or horizontal axis of the visual field increases the tendency to rotate.

As previously stated, on the basis of the statistical analysis the remaining five research hypotheses could not be rejected. Therefore, it was concluded that 1) the four variations in ground-shape did not differentially affect the occurrence of rotation; 2) there was no specific combination of a particular figure with a particular ground or with a particular orientation, that elicited significantly more rotation than any other such combination; 3) no single orientation when combined with any one of the four ground shapes significantly affected the occurrence of rotation; and 4) there was

no instance in which a combination of any one of the three figures, with any one of the four grounds in any one of the three orientations which produced significantly more rotation than any other such possible combination.

On the basis of the current findings and those of existing research, the following rationale for the rotation of the Bender configurations studied is suggested: Rotation is a function of the combined influence of 1) the relative stability or instability of the different gestalten and 2) the relative congruence or incongruence between the fixed axis of the stimulus design and either the vertical or horizontal axis of the visual field. It is proposed that those gestalten which are not seen as being comprised of separate units are more stable than gestalten wherein segregated units are perceived. Secondly, the stability of a figure is also a function of whether or not a quality of movement is associated with the stimulus. Figures to which a quality of movement is associated are less stable than are stimulus figures which do not embody this quality. Congruence exists when the fixed axis of the stimulus design corresponds with either the vertical or horizontal axis of the visual field. Incongruence exists when the fixed axis is at an angle of 45 degrees to either the vertical or horizontal axis of the visual field. Finally, the more stable the stimulus figure and the more congruent figure and ground, the less the tendency to rotate;

the more unstable the stimulus figure and the less congruent the relationship between figure and ground the greater the tendency to rotate.

Acceptance of this rationale is subject to future experimental verification. It is suggested that, based on this rationale, a new set of stimuli be constructed for which a predicted order for the occurrence of rotation could be hypothesized. These hypotheses should then be experimentally tested. Should the predicted order be obtained, further credence would accrue to the rationale.

Secondly, with respect to incongruence between figure and ground, the normal subject may place primary importance on the incongruence between properties of the figure and paper-shape, rather than on incongruence between these same properties and the ground-shape of the original stimulus. If this is the case then asking the subject to draw his reproduction on paper the same shape as the ground shape of the original stimulus, should produce less rotation. Thus it is suggested that the present study be repeated using drawing paper in the shape of a circle, diamond, square and rectangle.

It is also suggested that this study be repeated, in the exact manner outlined in Chapter II, on a comparable population of organic and psychotic female patients. Using the data obtained in the present research as the data for a control group, on the basis of Shapiro's findings it could

be hypothesized that the new experimental group would rotate significantly more than would the controls.

## ANNOTATED BIBLIOGRAPHY

Bender, Laretta, "A Visual-Motor Gestalt Test and Its Clinical Use", American Orthopsychiatric Association, Research Monographs, No. 3, 1938, New York, vi-176 p.

This monograph presents a detailed discussion of the development of the visual-motor gestalt function in children, as it is manifested in the ability to reproduce nine of Wertheimer's geometric designs. The Gestalt principles upon which the various designs are based are presented, along with a description of the deviations in reproduction most common to various clinical disorders. This book is a must for a meaningful understanding of deviations in Bender-Gestalt reproductions.

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

The author suggests that the different properties of stimulus objects are of varying importance in determining the ultimate response. Some properties of the stimulus may be altered with no resultant change in the response. Other stimulus properties can not be varied without a resultant change in response. The article is of import in the attention it focuses on the core properties of a visual stimulus.

Fuller, Jerry B. and Gilles Chagnon, "Factors Influencing Rotation in the Bender-Gestalt Performance of Children", Journal of Projective Techniques, Vol. 26, No. 1, March 1962, p. 36-46.

This study attempts the development of a theoretical rationale for the occurrence of Bender-Gestalt rotation in normal, neurotic and schizophrenic children between the ages of eight and fifteen years. Based on their results the authors suggest that the more emotionally disturbed, excited or aroused the individual, the less he is able to use cues which would enable him to avoid rotation. Of the five Bender designs studied, Design 3 elicited the most rotation, followed closely by Design A. Vertical orientation of the figure resulted in significantly more rotation than horizontal orientation of the figure, and diamond shape more rotation than rectangular shape. One major contribution of this study rests in the attention it focuses on the possible importance of rotations of less than 45 degrees.

Fuller, Gerald B. and James T. Laird, "The Minnesota Percepto-Diagnostic Test", Special Monograph Supplement, Vol. 19, No. 1, of the Journal of Clinical Psychology, issue of January 1963, p. iii to 34.

This monograph represents the formal presentation of The Minnesota Percepto-Diagnostic Test, (MPD), an outgrowth of the earlier work of Fuller and Chagnon. Included are a review of five research projects leading to the development of the MPD, a statement of the theoretical rationale, the standardization procedure for both children and adults, MPD administration and scoring procedures, and a section on interpretation of the obtained protocols.

The MPD consists of gestalten which the subject is asked to reproduce. These reproductions are subsequently scored for degrees of rotation. The purpose of the MPD is the rapid and objective differentiation between psychiatrically disturbed, organic, and normal adults or children; and, is also regarded to be a means of determining whether the etiology of reading disability in children is organic brain damage, primary retardation, or secondary retardation. It is proposed that rotation increases as ambiguity and instability of perceived figures increases.

Aside from its proposed value as a diagnostic technique, the MPD represents one of the initial and more thorough attempts to evaluate the diagnostic significance of specific and minor deviations from the stimulus design. This article was of major assistance in providing a theoretical point of reference.

Goldstein, Kurt and Martin Scheerer, "Abstract and Concrete Behavior: An Experimental Study with Special Tests", in the Psychological Monographs, Vol. 53, No. 2, Whole No. 239, 1941, p. 32-57.

This portion of the monograph deals with the subject's ability to reproduce colored designs with blocks. The authors propose that two different approaches in the reproduction of the design are possible, the abstract and the concrete. In organic patients failures are attributed to varying degrees of impairment of the abstract attitude. Among other points, specific reference is made to concrete dependence on the factor of position. Increased difficulty in the reproduction of the designs was found to occur when the design was oriented on an angle, and when there was incongruency between the position of the design and that of the surrounding ground. With respect to position, the findings were interpreted in terms of the Law of Prägnanz. Only a small portion of the total monograph was used.

Helson, Harry, "The Fundamental Propositions of Gestalt Psychology", The Psychological Review, Vol. 40, No. 1, January 1933, p. 13-32.

A succinct, well organized presentation of the basic propositions of the Gestalt theorists. The article covers the following topics: 1) what configurations are and are not, 2) the specific properties of configurations, 3) types of configurational phenomena, 4) laws governing configurational changes, 5) the relations of configurations to their members, 6) the relations of members to their configurations, and 7) general factors favoring configurational phenomena.

Pascal, Gerald R. and Barbara J. Suttell, The Bender-Gestalt Test. Quantification and Validity for Adults, Grune and Stratton, New York, 1951, v-274 p.

This book presents a detailed, objective scoring procedure for the evaluation of Bender-Gestalt reproductions. Test standardization, reliability and validity are discussed. Also included is a discussion of the test scores as a function of sex, drawing ability, I. Q., age, and education.

This reference is a good source of information on factors related to the ability of the subject to execute the designs.

Shapiro, M. B., "Experimental Studies of a Perceptual Anomaly: III. The Testing of an Explanatory Theory", Journal of Mental Science, Vol. 99, No. 416, July 1953, p. 394-409.

The third in a series of three articles by the author. All three articles were devoted to the development and testing of an explanatory theory for the rotation of block designs. Three laws for the occurrence of rotation were formulated. The three experiments represent a very well organized and systematic approach to the understanding of the rotation of block designs and contributed significantly to the development of the present project.

Tolor, A., "Structural Properties of the Bender-Gestalt Test Associations", Journal of Clinical Psychology, Vol. 13, No. 2, April 1957, p. 176-178.

A study of the associative meaning of the Bender designs, as reported by fifty neuropsychiatric patients. Of value in interpreting the results of the present research.

-----, "The 'Meaning' of Bender-Gestalt Test Designs: A Study in the Use of the Semantic Differential", Journal of Projective Techniques, Vol. 24, No. 4, December 1950, p. 433-438.

A refinement of the method used in Tolor's 1957 experiment. Provides data on the associative meaning of the Bender designs to sixty-eight college students. With respect to the present research, the findings show that in non-patient subjects a quality of movement is also associated with Bender Design 3.

Yates, A. J., "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, 1956, p. 761-771.

Attempts to define more accurately the conditions under which the block design rotation effect could be induced in normal subjects. Concludes that size of the room, distance of the stimulus card from the edge of the table, and previous experience of the subjects do not significantly affect the frequency of occurrence of rotation. Rotation was found to be more frequent when the design was reproduced on black felt. This study was of help in determining the conditions under which the experimental stimuli would be administered.

APPENDIX 1

WAHLER CONVERSION SCORES

APPENDIX 1

WAHLER<sup>a</sup> CONVERSION SCORES

Table IV.-

Shiplay Estimates of WAIS V.I.Q.

<u>Average Intelligence</u>		<u>Superior Intelligence</u>	
<u>V+A</u> <sup>b</sup>	<u>WAIS Estimate</u> <sup>c</sup>	<u>V+A</u>	<u>WAIS Estimate</u>
29	90	48	111
30	91	49	113
31	92	50	114
32	93	51	115
33	94	52	116
34	96	53	117
35	97	54	118
36	98	55	119
37	99	56	121
38	100	57	122
39	101	58	123
40	102	59	124
41	103	60	125
42	105		
43	106		
44	107		
45	108		
46	109		
47	110		

<sup>a</sup> These scores were obtained from conversion tables supplied in personal correspondence with H. J. Wahler. See footnote No. 6, Page 39 of this manuscript.

<sup>b</sup> Add the Vocabulary and Abstract Reasoning scores unweighted.

<sup>c</sup> The above Verbal I. Q. estimates are adult norms. The sample consisted of 105, non-patients from the vicinity of Columbus, Ohio.

**APPENDIX 2**

**RAW DATA**

APPENDIX 2

RAW DATA

Table V.-

Degrees of Rotation Produced by Seventy-Two subjects on Design 1 for the Four Grounds and Three Orientations.

Orientation	Ground Shape			
	Circle	Diamond	Square	Rectangle
Horizontal	2	0	0	1
	1	0	1	2
	0	1	2	0
	0	1	0	0
	1	0	1	1
	2	0	1	0
Vertical	2	1	2	0
	0	0	3	1
	1	40	1	1
	1	0	1	90
	2	7	1	0
	1	1	2	2
Oblique	5	1	14	4
	3	11	1	5
	4	41	9	11
	3	2	84	5
	3	46	10	2
	2	40	0	3

Table VI.-

Degrees of Rotation Produced by Seventy-Two Subjects on  
Design 3 for the Four Grounds and Three Orientations.

Orientation	Ground Shape			
	Circle	Diamond	Square	Rectangle
Horizontal	4	0	3	1
	3	3	0	0
	4	0	12	1
	2	6	1	3
	4	2	2	3
	86	49	0	0
Vertical	2	0	2	1
	1	0	3	0
	0	4	2	1
	4	8	2	2
	0	2	0	0
	0	6	2	2
Oblique	1	17	5	15
	30	13	10	8
	23	6	4	14
	54	10	16	65
	7	10	10	4
	3	0	81	3

Table VII.-

Degrees of Rotation Produced by Seventy-Two Subjects on  
Design E for the Four Grounds and Three Orientations.

Orientation	Ground Shape			
	Circle	Diamond	Square	Rectangle
Horizontal	1	1	2	3
	2	1	1	1
	0	1	0	2
	0	4	0	3
	3	0	2	1
	2	3	1	1
Vertical	0	2	2	1
	0	1	0	1
	1	1	0	1
	1	1	1	2
	1	1	2	2
	1	0	5	3
Oblique	9	14	5	10
	1	10	9	14
	4	10	4	1
	7	3	6	0
	0	43	2	2
	3	6	1	2

APPENDIX 3

ABSTRACT OF  
The Effect of Some Stimulus Variations  
on the Rotation of Bender-Gestalt Configurations  
in Non-Patient Young Adult Females

## APPENDIX J

### ABSTRACT OF

#### The Effect of Some Stimulus Variations on the Rotation of Bender-Gestalt Configurations in Non-Patient Young Adult Females<sup>1</sup>

Existing research on the Bender-Gestalt test has focused its attention primarily on the integrative state of the organism. Only a few studies, those dealing with the occurrence of rotation, have concentrated on the role played by the stimulus. These research projects have placed primary attention on the occurrence of rotation in the reproductions of children and psychiatric in-patients. The purpose of the present research was to study the effect of variations of figure-shape, ground-shape, and orientation of figure to the ground, on the occurrence of rotation in a non-patient, adult population. The population studied consisted of 216 female, student nurses of average or above intelligence and between the ages of eighteen and twenty-five years.

Thirty-six stimulus cards, representing all possible combinations of three Bender designs, four ground-shapes, and three orientations of figure to ground, comprised the final group of stimuli. Included were Bender Designs 1, 3 and 8;

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<sup>1</sup> Virginia E. Schoen, doctoral thesis presented to the School of Psychology and Education of the University of Ottawa, Ontario, May 1964, x to 101 p.

circular, square-shaped, diamond-shaped and rectangular grounds; and vertical, horizontal and oblique orientations.

The specific research hypotheses were as follows:

1. There is no significant difference between any two of the three figures for the degree of rotation produced.
2. There is no significant difference between any two of the four grounds for the degree of rotation produced.
3. There is no significant difference between any two of the three orientations for the degree of rotation produced.
4. There is no significant interaction between the three figures and four grounds for the degree of rotation produced.
5. There is no significant interaction between the three figures and three orientations for the degree of rotation produced.
6. There is no significant interaction between the four grounds and three orientations for the degree of rotation produced.
7. There is no significant interaction among the three figures, four grounds, and three orientations for the degree of rotation produced.

Rotation was defined as the smallest degree discrepancy between a fixed axis of the stimulus design and that of the reproduction, as measured by a TARCO n° adjustable angle scale.

Statistical analysis resulted in the rejection of hypotheses 1 and 3. The remaining five hypotheses could not be rejected. These results were discussed in some detail,

with the discussion culminating in the development of a tentative rationale for the occurrence of Bender-Gestalt rotation under the conditions inherent in the study. Suggestions for future research were offered.