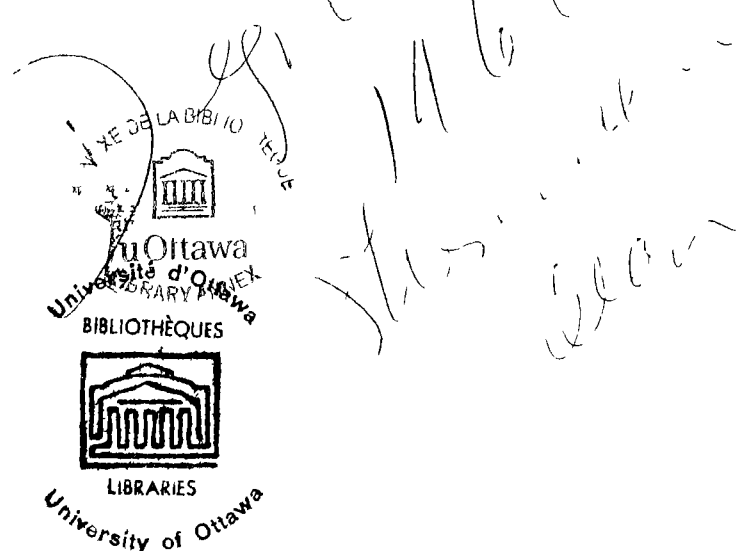


THE EFFECT OF AGE OF CHILDREN AND EXPOSURE TIME OF  
STIMULUS ON ROTATION IN A VISUAL-MOTOR TASK

by Margaret E. Gillespie

Thesis presented to the Faculty of  
Psychology and Education of the  
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## CURRICULUM STUDIORUM

Margaret E. Gillespie was born August 10, 1932, in Toronto, Canada. She received her Bachelor of Arts degree in Honour Psychology from the University of Toronto, in 1954.

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## INTRODUCTION

Very few authors have attempted to experimentally evaluate Bender's theoretical formulations concerning the visual-motor functioning of non-pathological groups. The majority of investigations have studied the diagnostic implications of deviations in visual-motor performance on the Bender Visual Motor Gestalt Test.<sup>1</sup> However, until there is more scientific knowledge concerning the factors influencing the visual-motor functioning of the "normal" population the implications of these diagnostic studies cannot be fully evaluated.

Bender maintains that within the "normal" population the accuracy in the reproduction of Gestalt Designs is determined by developmental processes<sup>2</sup> and that when the time for viewing Gestalt Designs is limited, more developmentally primitive reproductions are obtained.<sup>3</sup> The purpose of this study was to investigate the validity of these statements in one aspect of visual-motor functioning--rotation (which is usually defined as the axial turning of a reproduced design from its position in the original stimulus).

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1 Laretta Bender, A Visual Motor Gestalt Test and Its Clinical Use, New York, American Orthopsychiatric Association, 1938, xi-176 p.

2 Ibid., p. 113.

3 Ibid., p. 50.

Fabian<sup>4</sup> and Koppitz<sup>5</sup> have investigated the developmental aspects of rotation and both suggest that by the age of eight years rotation in the reproduction of Gestalt Designs is not a function of developmental factors. Fabian's investigation into the effect of a five second limit on exposure time indicated that children's rotation of Gestalt Designs increased when the temporal factor was limited. However, because of Fabian's poor experimental design, further scientific evaluation of his results seemed warranted.

This study attempted to cross-validate and extend Fabian's findings. The effect of age of children and exposure time of stimulus on rotation was investigated by means of a modification of the Minnesota Percepto-Diagnostic Test<sup>6</sup> which is made up of two Gestalt Designs.

Chapter one presents the theoretical and experimental background on children's rotations in the reproduction of Gestalt Designs. The specific hypotheses and consequent experimental design are the subjects of chapter two. Finally, the experimental results and their implications are presented in chapter three.

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<sup>4</sup> A.A. Fabian, "Vertical Rotation in Visual-Motor Performance - Its Relationship to Reading Reversals", Journal of Educational Psychology, Vol. 36, No. 3, March 1945, p. 129-154.

<sup>5</sup> Elizabeth Munsterberg Koppitz, The Bender Gestalt Test for Young Children, New York, Grune and Stratton, 1964, 195 p.

<sup>6</sup> Gerald B. Fuller and James T. Laird, "The Minnesota Percepto-Diagnostic Test", Special Monograph Supplement, No. 16, Journal of Clinical Psychology, January 1963, 32 p.

## CHAPTER I

### REVIEW OF THE LITERATURE

#### 1. General Considerations.

Rotations in visual-motor tasks have been studied by many authors from the developmental and diagnostic points of view. It has been generally accepted that children's rotations decrease as age increases<sup>1,2,3</sup> and that rotations increase when there is impairment in perceptual-motor functioning due to pathological factors.<sup>4,5,6,7</sup> Also, it has been maintained that when the temporal factor in perception is reduced - more primitive type of visual-motor functioning occurs and rotations increase.<sup>8,9</sup>

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1 Laretta Bender, A Visual Motor Gestalt Test and Its Clinical Use, New York, American Orthopsychiatric Association, 1938, xi-176 p.

2 A.A. Fabian, "Vertical Rotation in Visual-Motor Performance - Its Relationship to Reading Reversals", Journal of Educational Psychology, Vol. 36, No. 3, March 1945, p. 129-154.

3 Elizabeth Munsterberg Koppitz, The Bender Gestalt Test for Young Children, New York, Grune and Stratton, 1964, 195 p.

4 Bender, Op. Cit.

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

6 Alexander Tolor and Herbert C. Schulberg, An Evaluation of the Bender-Gestalt Test, Springfield, Illinois, Thomas, 1963, xxiii-229 p.

7 Koppitz, Op. Cit.

8 Bender, Op. Cit.

9 Fabian, Op. Cit.

Investigations have been made into the rotations of Block Designs<sup>10,11</sup> and Gestalt Designs of both adults and children.<sup>12,13,14</sup> Since the present research was concerned with children's rotations of Gestalt Designs the following review of the literature will deal only with those studies that investigated this specific area.

When Bender introduced the Bender Visual-Motor Gestalt Test<sup>15</sup> she stated that the reproductions of the designs were influenced by the maturational level of an individual and his pathological state which was either organically or functionally determined.<sup>16</sup> Since that time, the majority of experiments on the drawing of Gestalt figures have investigated their value in terms of differential diagnosis. In the following discussion, the theories and studies

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10 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.

11 Aubrey J. Yates, "Rotations of Drawings by Brain Damaged Patients", Journal of Abnormal and Social Psychology, Vol. 53, 1956, p. 176-181.

12 Fabian, Op. Cit.

13 R.M. Griffith and V.H. Taylor, "Bender-Gestalt Figure Rotation", Journal of Consulting Psychology, Vol. 25, 1961, p. 89-90.

14 Gerald B. Fuller and James T. Laird, "The Minnesota Percepto-Diagnostic Test", Special Monograph Supplement, No. 16, Journal of Clinical Psychology, January 1963, 32 p.

15 Hereafter referred to as the Bender-Gestalt.

16 Bender, Op. Cit., p. 5.

involved in the diagnostic implications of rotations will be briefly considered. Then, the two variables that were under consideration in this research (age and exposure time) will be discussed. Finally, the general hypothesis will be presented.

Prior to the presentation of the various studies on rotation, a general comment should be made. It is difficult to compare the research that has been done on rotation because of the various ways in which this variable has been defined--ninety degrees,<sup>17</sup> forty-five degrees,<sup>18</sup> thirty degrees<sup>19</sup> and actual degree points.<sup>20</sup> Also, there are three types of rotation that could occur: (1) The stimulus card may be rotated in reference to the drawing paper and the design copied accurately in that position. (2) The paper may be rotated and the design copied accurately. (3) The design card and the paper may be in direct alignment and the main axis of the drawing varied from the main axis of the

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17 Virginia G. Halpin, "Rotation Errors Made by Brain Injured and Familial Children on Two Visual-motor Tests", American Journal of Mental Deficiency, Vol. 59, 1955, p. 485-489.

18 Koppitz, Op. Cit.

19 S.B. Chorost, et al., "Bender-Gestalt Rotations and EEG Abnormalities in Children", Journal of Consulting Psychology, Vol. 23, 1959, p. 559.

20 Fuller and Laird, Op. Cit.

stimulus design.<sup>21,22</sup> Although most authors have defined the degrees of rotation that they considered significant, only a few have indicated the type of rotation that they were measuring.

## 2. Rotation and Differential Diagnosis.

Bender was one of the few authors who attempted to present a theoretical explanation for increased rotation when psychopathology existed. She presented her theory clearly in her introductory remarks to An Evaluation of the Bender Gestalt Test. She stated:

Since vortical movement is the basic principle in visual perception, immature, retarded or regressed subjects experience a primitive tendency to increase movement in their perceived objects which results in rotation.<sup>23</sup>

Thus, according to Bender, rotation occurs either through lack of maturation in the visual-motor area or through regression to a more primitive developmental level.

Fuller and Chagnon are the only other authors who have attempted to present a theoretical explanation for the increased rotation of Gestalt Designs in the emotionally disturbed child. They concluded from the studies of

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<sup>21</sup> Max L. Hutt and Gerald B. Briskin, The Clinical Use of the Revised Bender-Gestalt Test, New York, Grune and Stratton, 1960, p. 62.

<sup>22</sup> Fuller and Laird, Op. Cit., p. 10.

<sup>23</sup> Tolor and Shulberg, Op. Cit., p. xiv.

Duffy<sup>24</sup> and Easterbrook<sup>25</sup> that "rotations may be influenced by a lack of cue utilization due to emotional excitation, arousal or disturbance."<sup>26</sup> These authors maintain that when an individual is under emotional stress he is unable to use the necessary cues for adequate performance and rotations increase.

Considerable interest has been taken into the usefulness of Gestalt rotations in differentiating between groups of organic and non-organic children and groups of normal, neurotic and schizophrenic children. With the exception of Halpin's<sup>27</sup> study (in which rotation was defined as a ninety degree turning of the entire figure) studies have indicated that organic children rotate Gestalt Designs more than non-organic children. However, the significance of the results of some of these studies are questionable. For example

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

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

26 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. 39.

27 Virginia G. Halpin, "Rotation Errors Made by Brain Injured and Familial Children on Two Visual-Motor Tests", American Journal of Mental Deficiency, Vol. 59, 1955, p. 485-489.

Hanvik<sup>28</sup> failed to provide an adequate research design. Also, the results of Chorost, et al.<sup>29</sup> indicated that the presence of one or more rotations (defined as a thirty degree deviation from the normal axis) could adequately predict abnormal EEG's in only sixty-five per cent of the cases in their sample.

Studies in which actual degrees of rotation were measured have yielded more significant experimental results. Fuller and Shaw<sup>30</sup> found that rotation scores could differentiate the etiology of children's reading difficulties into three categories: primary reading retardation, secondary reading retardation and retardation due to organic brain damage. Although Byrd's<sup>31</sup> diagnostic categories were very broad, he found that rotation was one of the factors that differentiated between children in need of psychotherapy and those judged to be well-adjusted. Fuller and Chagnon<sup>32</sup> were able to significantly differentiate between normal, emotionally

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28 L.J. Hanvik, "A Note on the Rotations in the Bender-Gestalt Test as Predictors of EEG Abnormalities in Children", Journal of Clinical Psychology, Vol. 9, 1953, p. 399.

29 Chorost, et al., Op. Cit.

30 G.B. Fuller and C.N. Shaw, "Visual Orientation in Reading Disability: Diagnostic Considerations", Quarterly Journal of Child Psychiatry, No. 2, 1963, p. 404-404.

31 E. 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, 1956, p. 127-136.

32 Fuller and Chagnon, Op. Cit.

disturbed and schizophrenic children by rotation scores on Bender-Gestalt designs A and 3 presented on three different backgrounds.

The literature suggests that although there has been a considerable number of studies on the diagnostic implications of children's rotations on Gestalt Designs, there is a sparsity of theoretical formulation. The majority of studies have been concerned with demonstrating group differences and, as Tolor and Schulberg state,

The time is long overdue for psychologists to progress beyond the more primitive stage of demonstrating group differences on the Bender and to attend to those aspects of Bender behavior that will explicate the basic psychological processes and special adaptive mechanisms.<sup>33</sup>

### 3. Rotation and Development.

Although several authors have indicated that distortions (including rotation) decrease as the age of children increases,<sup>34,35</sup> only three extensive investigations into the developmental aspects of Bender-Gestalt reproductions have been made.

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33 Tolor and Schulberg, Op. Cit., p. 135.

34 Pascal and Suttell, Op. Cit.

35 F.M. Lachmann, "Perceptual-Motor Development in Children Retarded in Reading Ability", Journal of Consulting Psychology, Vol. 24, 1960, p. 427-431.

When Bender<sup>36</sup> presented the Bender-Gestalt test she described the maturational process of visual-motor behaviour in the developing child and standardized her test on eight hundred children in terms of developmental characteristics. She maintained "The test may [...] be considered of value as a maturational test of performance in the visual-motor gestalt function between the ages of four and eleven [...]"<sup>37</sup> Although she presented a chart<sup>38</sup> with illustrations of typical reproductions of the Gestalt Designs at the various age levels, she failed to present further objective criteria for the evaluation of the maturational levels of performance.

Bender did not refer directly to the significance of rotation in developmental terms. However, she made many references to vertical movement in drawings and described it as a maturational phenomenon that decreased as age increased.

Fabian<sup>39</sup> was the first author to report normative data on children's rotations of Gestalt Designs. Fabian's primary interest was in experimentally establishing the positive relationship between reading disabilities and the

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36 Bender, Op. Cit.

37 Ibid., p. 113.

38 Ibid., p. 132.

39 Fabian, Op. Cit.

vertical rotation of Gestalt Designs. To study this phenomenon he obtained data on the frequency of rotation in normal controls.

He presented five of the Bender-Gestalt Designs (A, 3, 4, 5 and 8) to 586 public school children ranging in age from five to nine years. His results indicated that the rotation of Gestalt Designs is a common phenomenon between five and six and one half years of age (over fifty per cent of the children rotated one or more designs). He noted that rotations decreased considerably between six and one half and seven and one half years (approximately twenty-two per cent of the children showed rotations). There was again a considerable decrease in rotation between seven and one half and nine years, (approximately seven per cent of the children showed rotations).

The significance of Fabian's results are questionable because of the defects in his experimental design. He failed to define rotation or how he differentiated vertical rotation from other forms of rotation. Also, his results were presented in percentages and no statistical analysis was used to establish their significance. Despite these defects, his results did suggest that rotation decreases as the age of children increases.

It was not until Koppitz<sup>40</sup> presented her Developmental Scoring System that further investigation was made into the developmental aspects of the Bender-Gestalt. Her scoring system was standardized on more than twelve thousand public school children and provided criteria for evaluating the perceptual maturity of children from five to ten years of age. Rotation was regarded as one of the developmental factors and was defined as a forty-five degree variation from the axis of the stimulus design. Koppitz suggested that rotation could be expected in children until about eight years of age. After eight years she considered rotation to be indicative of organic or emotional disturbances.

It can be noted that there has been little investigation into the developmental aspects of children's rotations on Gestalt Designs and that there is a need for further experimental exploration in this area.

#### 4. Rotation and Exposure Time.

Bender maintained that the tachistoscopic presentation of gestalt designs resulted in more primitive reproductions and confirmed in many ways the principles of the development of visual-motor Gestalten.<sup>41</sup> The tachistoscopic

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<sup>40</sup> Koppitz, Op. Cit.

<sup>41</sup> Bender, Op. Cit., p. 50.

presentation of Gestalt Designs has been used in studying diagnostic categories<sup>42,43</sup> and ego strength<sup>44</sup> in adults.

Fabian<sup>45</sup> is the only author who has investigated the influence of the temporal factor in the reproduction of Gestalt Designs of children. He administered five of the Bender-Gestalt Designs to 326 children under conditions of five seconds exposure and no time limit of exposure. The children ranged in age from seven and one half to nine years. He found that thirty-five per cent of the seven and one half year olds showed rotational distortions under conditions of limited exposure time whereas only twenty per cent showed rotation under no limit of exposure time. In the remaining age groups, rotations were two to four times more common when exposure time was limited. He also noted that vertical rotation predominated. From his study he concluded that,

The latent tendency to 'verticalization' demonstrates itself in this experiment. The reappearance of this tendency would coincide with the concept of regression in function once optimum conditions are removed.<sup>46</sup>

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<sup>42</sup> Hutt and Briskin, Op. Cit., p. 42.

<sup>43</sup> J. Lindsay, "The Bender Gestalt Test and Psychoneurotics", Journal of Mental Science, Vol. 100, 1954, p. 377-379.

<sup>44</sup> S.J. Korchin and H. Basowitz, "The Tachistoscopic Bender-Gestalt Test", American Psychologist, Vol. 9, Abstract, 1954, p. 408.

<sup>45</sup> Fabian, Op. Cit.

<sup>46</sup> Ibid., p. 140.

The defects in Fabian's experimental design have been stated previously. These defects throw doubt on the significance of his findings. However, his results do suggest that when exposure time is reduced, rotation increases. Further experimental investigation is needed to reject or validate his findings.

#### 5. Summary and General Hypothesis.

The review of the literature indicates that very little research has been done into the effect of reduced exposure time on the rotation of Gestalt Designs by children. Bender<sup>47</sup> is the only author who has attempted to present a theoretical explanation for distortions in performance when the temporal factor is minimized. She has maintained that more primitive reproductions will result and Fabian<sup>48</sup> demonstrated that rotations in the Gestalt Designs of children increased when the exposure time of the stimulus was limited to five seconds.

On the basis of the two previous research studies into the developmental aspects of rotation<sup>49,50</sup> it could be

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<sup>47</sup> Bender, Op. Cit.

<sup>48</sup> Fabian, Op. Cit.

<sup>49</sup> Ibid.

<sup>50</sup> Koppitz, Op. Cit.

expected that after the age of seven years rotations would no longer be significant in terms of developmental factors.

The two independent variables in this research are age and exposure time and the dependent variable is rotation. Rotation was said to exist when a reproduced design was turned on its main axis relative to the position of that axis in the original stimulus. The tool used in this research was a modification of the Minnesota Percepto-Diagnostic Test.<sup>51</sup> This test is designed to measure the degree of rotation of two Gestalt Designs on three backgrounds.

It is difficult to formulate the expectations in this research. According to the findings of Koppitz<sup>52</sup> and Fabian,<sup>53</sup> age alone should have little influence on rotation after seven years. According to Fabian,<sup>54</sup> variations in exposure time should result in differences in the amount of rotation produced. Although there has been no research done on the interaction of age and exposure time with respect to rotation, there could be interaction between these two variables.

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<sup>51</sup> Fuller and Laird, Op. Cit., hereafter referred to as the MPL.

<sup>52</sup> Koppitz, Op. Cit.

<sup>53</sup> Fabian, Op. Cit.

<sup>54</sup> Ibid.

On the basis of previous studies, the following general hypothesis was formulated. As exposure time decreases, rotation increases in the reproduction of Gestalt Designs by children.

The background theories and studies have been described and the general hypothesis presented. The next chapter will present the experimental design used in testing the general hypothesis.

## CHAPTER II

### EXPERIMENTAL DESIGN

This chapter describes the procedures used in testing the general hypothesis proposed in the preceding chapter.

It begins with a presentation of the specific research hypotheses and an outline of the statistical methods used to test the hypotheses. The sample population is then described and an explanation given for the choice of the various age groups and the controlled subject variables. A description of the tools used in the experiment is then presented. Finally, the testing and scoring procedures are described with emphasis on how they vary from the usual testing and scoring procedures of the MPD.

#### 1. Specific Research Hypotheses.

As the general hypothesis indicates, the present research was primarily directed toward investigating the effect of exposure time on rotation. However, since it was not known to what extent age and the interaction of age and exposure time might influence rotation, there were three specific hypotheses formulated in the null form:

- a) There is no significant difference between the amount of rotation produced by any two of the four exposure times.

- b) There is no significant difference between the amount of rotation produced by any two of the three age groups at each level of exposure time.
- c) There is no significant interaction between any of the four exposure times and any of the three age groups in the amount of rotation produced.

## 2. Statistical Procedures.

The original data were initially analysed by Analysis of Variance. A four by three fixed model was used to determine the effects of:

- a) exposure time on rotation;
- b) age on rotation;
- c) the interaction of age and exposure time on rotation.

F tests for rotation scores for the main effects and the interaction effect were determined. When indicated, the simple effects were calculated. Following the above analysis, t tests were used to determine the significance between the means of rotation scores for the variable that was found significant in the former analysis.

The Pearson product-moment coefficient of correlation was used to analyse the scorer and test-retest reliability studies that will be described later. Also, the retest data were analysed by Analysis of Variance.

### 3. subjects.

The subjects were 180 students (ninety boys and ninety girls) enrolled in five public schools of a metropolitan area. Sixty subjects were selected at each of the following age levels: eight years, eleven years and fourteen years. Eight years of age was defined as a chronological age of eight years zero months to eight years eleven months. The other age levels were similarly defined.

Eight years of age was selected as the youngest age level because Fabian<sup>1</sup> and Koppitz<sup>2</sup> had indicated that the rotation of Gestalt Designs decreased considerably after seven years of age. The eleven and fourteen year age levels were arbitrarily selected.

Three age groups were chosen in order to investigate the effect of exposure time on rotation at more than one age level and to study the developmental relationship between exposure time and rotation.

The controlled subject variables were three in number:

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1 A.A. Fabian, "Vertical Rotation in Visual-Motor Performance - Its Relationship to Reading Reversals", Journal of Educational Psychology, Vol. 36, No. 3, 1945, p. 129-154.

2 Elizabeth Munsterberg Koppitz, The Bender Gestalt Test for Young Children, New York, Grune and Stratton, 1964, 195 p.

a) The subjects were required to have an Intelligence Quotient of eighty to 110 as measured by the Otis Alpha Group Intelligence Test - Form A-S.

Fuller and Laird stipulated that the MPD should be used only with children whose intellectual ability falls within this range. "Children who are of lower intelligence often rotate more and those who have higher intelligence tend to rotate less [...]"<sup>3</sup>

b) The subjects selected were children who had not been referred as a problem to the school psychological or psychiatric service. This variable was controlled in an attempt to eliminate those subjects who had emotional or perceptual problems that were hampering their academic or social adjustment. Many authors<sup>4,5,6</sup> have demonstrated that rotation increases in children with organic or emotional problems.

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3 Gerald B. Fuller and James L. Laird, "The Minnesota Percepto-Diagnostic Test", Special Monograph Supplement, No. 16, Journal of Clinical Psychology, January 1963, p. 25.

4 T.J. Hanvik, "A Note on the Rotations in the Bender-Gestalt Test as Predictors of EEG Abnormalities in Children", Journal of Clinical Psychology, Vol. 9, 1953, p. 399.

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

6 E. 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, 1956, p. 127-136.

c) Only right-handed subjects were selected. Although the extent to which dominance influences visual-motor functioning has not been fully investigated, there are authors<sup>7</sup> who have suggested that it could be an important factor.

Controlling the sex of the subjects was not considered necessary since previous investigations<sup>8,9</sup> had shown that sex was not a significant variable in the reproduction of Gestalt Designs.

#### 4. Instrument.

The test used was a modification of the MPD. This test consists of two Gestalt Designs on three backgrounds and is based on the rationale that figure-ground relationships interact. The authors state that when the figure is incongruent to the frame or when there is a vertical figure and diamond frame, rotation is increased.<sup>10</sup>

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<sup>7</sup> S.T. Orton, "Certain Failures in the Acquisition of Written Language: Their Bearing on the Problem of Cerebral Dominance", Archives of Neurology and Psychiatry, Vol. 22, 1929, p. 841-850.

<sup>8</sup> Koppitz, Op. Cit., p. 35.

<sup>9</sup> Gerald R. Pascal and Barbara J. Suttell, The Bender-Gestalt Test, Quantification and Validity for Adults, New York, Grune and Stratton, 1951, p. 20.

<sup>10</sup> Fuller and Laird, Op. Cit., p. 9.

Slides of the six figures were projected on to a white screen (three feet by three feet) by means of a Cavalcade slide projector. A Timex automatic timer was used to control exposure time. Sheets of white bondfast paper (eight and one half by eleven inches) and No. 2 pencils with erasers were used by the subjects for drawing.

#### 5. Testing Procedures.

Subjects were seen alphabetically from each classroom. The subjects were seen in pairs.

Blinds were drawn over the windows to darken the testing room. Each subject was seated at a plain surfaced desk. The two desks were placed two feet apart. The distance from the centre of each desk to the screen was six feet. The projector was placed on a table between and to the rear of the two desks so that when the design was projected on the screen it was twice the size of the card design.

Each subject was provided with a pencil. One sheet of paper was placed in the centre of each desk in such a way that the longest axis of the paper was perpendicular to the subject. To prevent rotation, the paper was attached with white photographic corners.

During the administration of the test the designs were projected on the screen one at a time in the prescribed order. The six designs were presented to each pair of

subjects under one of the following exposure times: no time limit, ten seconds, five seconds and one second.

The order of exposure time was systematically varied. The first pair of subjects was exposed to no time limit, the next pair to ten seconds, the next pair to five seconds and the next pair to one second. This procedure was repeated in the above order. Fifteen children from each age level were presented with one of the experimental conditions.

The following instructions were given to all subjects. "Sit directly in front of the paper on the desk. Put your name, age and school at the top of the paper."

When there was no time limit on exposure, the following instructions were given. "There will be six pictures shown on the screen in front of you, one at a time. Each picture will be shown for as long as you wish. Draw the picture on the paper in front of you. Number this drawing number one."

After the completion of design number one, the following instructions were given prior to each of the remaining five items. "Draw the picture on the paper in front of you. Number this drawing number [...]."

The following instructions were given when there was a limited exposure time. "There will be six pictures shown on the screen in front of you, one at a time. Each picture will be shown for [...] seconds. Look carefully at the

picture while it is shown and when it has gone draw it on the paper in front of you. Number this drawing number one."

After the completion of item one, the following instructions were given prior to each of the remaining five items. "Look carefully at the picture while it is shown and when it has gone, draw it. Number this drawing number [...]."

Questions asked by the subjects were answered by the repetition of an appropriate part of the directions.

As many subjects as could be obtained were retested after a seven day period. One hundred and thirty-eight subjects from the original sample of 180 subjects were retested under the same experimental conditions as in the original testing. The subjects were seen in the same room, were seated at the same desk, were exposed to the same exposure time and were given the same test directions.

#### 6. Scoring Procedure.

The six test items on each protocol were scored for degrees of rotation by the method advised in the manual of the MPD<sup>11</sup> with two exceptions. Zero degrees of rotation was recorded rather than one degree when no rotation was present. Protocols containing unscorable designs were rejected rather than being retained and assigning the unscorable item a score

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<sup>11</sup> Fuller and Laird, Op. Cit., p. 20-21.

of twenty-five. Then of the protocols of the eight year olds were rejected under these conditions.

Only whole numbers were used in recording scores. When fractional degrees were measured, they were rounded off to the next whole number. In items where it was unknown as to whether the rotation was clockwise or counter-clockwise the smaller rotation score was recorded.

The total score for the protocol was obtained by summing the rotation scores of the six individual items. Scores greater than twenty-five were used and not converted to twenty-five as instructed in the scoring system of the APD.<sup>12</sup> These scores were not converted because this study was investigating the actual amount of rotation under the previously described experimental conditions.

There were two scorers. In a scorer reliability study each scorer independently measured the degrees of rotation on the same one hundred test items.

The experimental procedures have been described and in the next chapter the results of the experiment and the discussion of the results will be presented.

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12 Ibid., p. 22.

## CHAPTER III

### RESULTS AND DISCUSSION OF RESULTS

The results of the experiment will be considered in three stages: a) The summary of the Analysis of Variance will be presented first, with some general comments on the results. b) The results of the reliability tests and the summary of the Analysis of Variance on the retest data will then be reported. c) In conclusion, the results will be considered in terms of the general hypothesis.

#### 1. Results.

The summary of the Analysis of Variance (reported in Table I) reveals that age was the only significant variable in this experiment ( $F = 23.32$  which is significant at the .0001 level of confidence). Exposure time ( $F = 1.71$ ) and the interaction of age and exposure time ( $F = .10$ ) were not significant in this overall statistical analysis.

From Table I it can be noted that the within cell variance (or error term) was high. To gain a further understanding of this variance the cell means and standard deviations were calculated. As can be seen in Table II and Figure 1 there was a wide discrepancy between the mean rotation scores of the eight year olds and the other two age groups. With the exception of the eleven year olds, the mean

Table 1.-  
Summary of Analysis of Variance.

Source of Variance	SS	df	Est. of Variance	F
Age	34,281.16	2	17,140.58	23.32 <sup>a</sup>
Exposure Time	3,752.07	3	1,250.69	1.71
Interaction	570.21	6	95.04	.10
Within Cell	122,750.87	168	730.66	

a Significant at  $p = .001$ .

Table II.-  
Means of Cells.

Age	Exposure Time			
	No limit	10 seconds	5 seconds	1 second
8 years	50.53	58.27	60.87	65.87
11 years	29.00	25.40	32.93	35.40
14 years	21.33	27.27	30.53	35.60

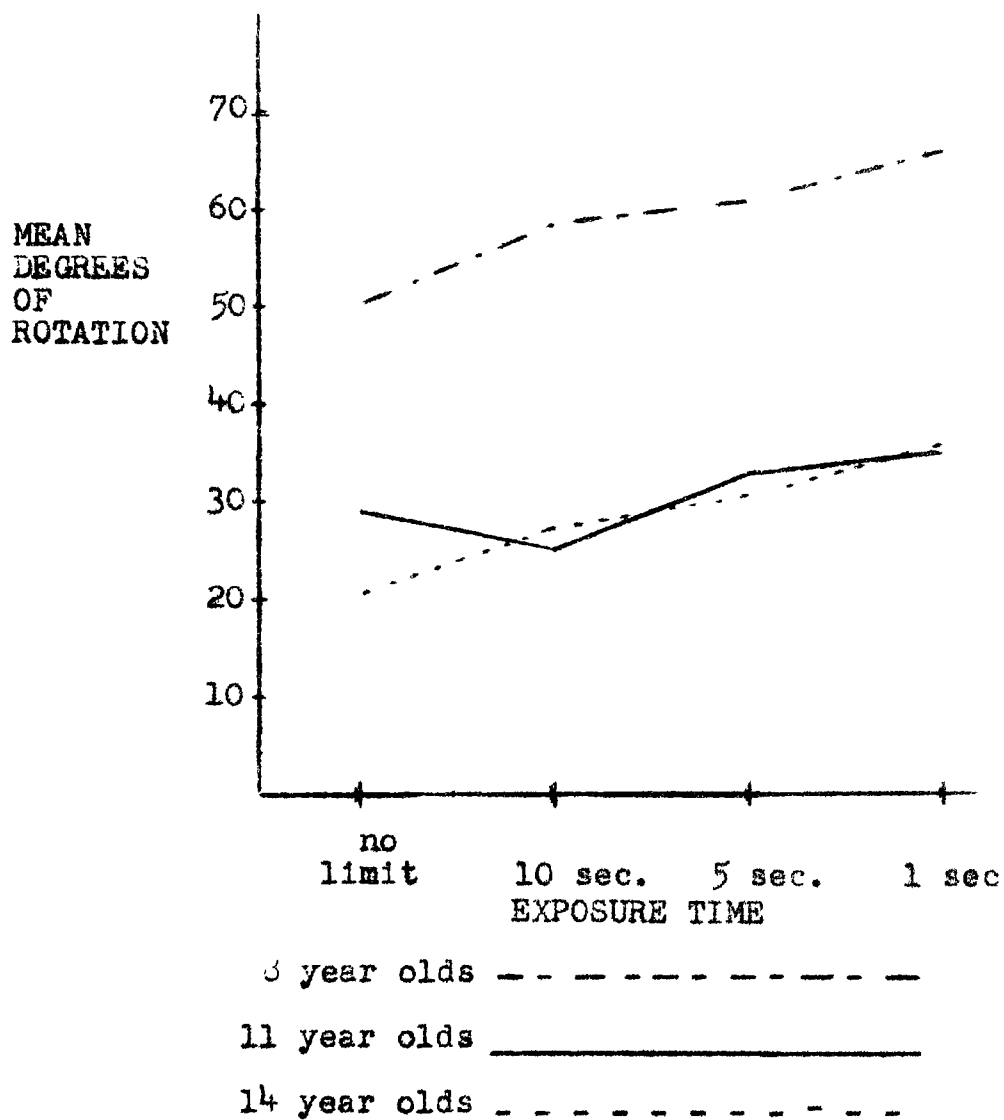


Figure 1.- Means of Cells.

rotation scores increased as exposure time was reduced. Also, with the exception of the eleven year olds, the standard deviations of the cells became greater as exposure time decreased, and became less as the age increased (see Table III).

The Analysis of Variance indicates that the null hypothesis regarding exposure time cannot be rejected and that, in this experimental design, exposure time was not a variable that significantly influenced rotation.

The null hypothesis regarding age was rejected. To further demonstrate the significance of the age variable in terms of rotation, an Analysis of Variance for the Simple Effects of Age was calculated (reported in Table IV).

The differences between the age means at the ten and one second exposure time were significant beyond the .01 level of confidence. At the "no limit" and five second exposures, the differences were significant beyond the .05 level of confidence.

To determine the significance between the means of age groups at each of the four exposure times t tests were used, (reported in Table V). For the comparison between the eight and fourteen and the eight and eleven year age groups, the t test results were significant at the .001 level of confidence at the "no limit" and ten second exposure times. The t test results for the same age groups were significant

Table III.-  
Standard Deviations of Cells.

Age	Exposure Time			
	No limit	10 seconds	5 seconds	1 second
8 years	16.72	26.93	43.12	62.62
11 years	10.45	8.65	15.43	17.81
14 years	7.93	11.50	13.45	16.81

Table IV.-

Summary of Analysis of Variance for Simple Effects of Age.

Source of Variance	SS	df	Est. of Variance	F
No Time Limit of Exposure	6,875.51	3	2,291.84	3.14 <sup>a</sup>
Ten Second Exposure	10,233.51	3	3,411.17	4.67 <sup>b</sup>
Five Second Exposure	8,530.71	3	2,843.57	3.89 <sup>a</sup>
One Second Exposure	9,221.65	3	3,073.88	4.21 <sup>b</sup>
Within Cell	122,750.87	168	730.66	

a Significant at  $p = .05$ .b Significant at  $p = .01$ .

Table V.-  
t Tests for Age at the Four Exposure Times.

Exposure Time	Ages	Means	t
No Limit	0-14	50.53-21.33	6.32 <sup>a</sup>
	0-11	50.53-29.00	4.12 <sup>a</sup>
	11-14	29.00-21.33	2.19 <sup>b</sup>
Ten Seconds	0-14	58.27-27.27	3.96 <sup>a</sup>
	0-11	58.27-25.40	4.35 <sup>a</sup>
	11-14	25.40-27.27	-.49
Five Seconds	0-14	60.87-30.53	2.51 <sup>b</sup>
	0-11	60.87-32.93	2.28 <sup>b</sup>
	11-14	32.93-30.53	.44
One Second	0-14	65.87-35.60	1.75
	0-11	65.87-35.40	1.75
	11-14	35.40-35.60	-.03

a Significant at  $p = .001$ .

b Significant at  $p = .05$ .

at the .05 level of confidence, at the five second exposure time. It was only at the "no limit" of exposure time that the t test results indicated significant differences between the means of the eleven and fourteen year age groups. None of the t test results at the one second exposure time were significant.

The null hypothesis for interaction was not rejected by the Analysis of Variance. The results of this experimental design indicate that rotation was not influenced by the interaction of the ages and exposure times that were used.

The results of the inter-scorer reliability test were in a range that is considered very high ( $r = .98$ ). However, the results of the test-retest reliability study were low ( $r = .39$ , significant at the .01 level of confidence). Because of the very low test-retest reliability an Analysis of Variance was calculated on the retest data to determine the extent to which the retest findings would confirm those of the original results. The summary of the Analysis of Variance on the retest data (reported in Table VI) reveals essentially the same results as were found in the original data.

Age was again the only significant variable influencing rotation ( $F = 24.93$ , significant beyond the .0001 level of confidence). Neither exposure time ( $F = 2.17$ ) nor the interaction of age and exposure time ( $F = .31$ ) were significant. These results suggest that, although the performances of the

Table VI.-

Summary of Analysis of Variance on Retest Data.

Source of Variance	SS	df	Est. of Variance	F
Age	23,401.45	2	11,740.73	24.93 <sup>a</sup>
Exposure Time	3,063.58	3	1,021.19	2.17
Interaction	870.17	6	145.03	.31
Within Cell	59,299.39	126		

<sup>a</sup> Significant at  $p = .0001$ .

subjects were not reliable, the patterns on the retest data support the original findings.

The statistical results of this experiment indicate that the general hypothesis cannot be accepted and that, in this design, rotation does not increase significantly as exposure time is reduced.

## 2. Discussion of Results.

The results of this experiment will be discussed in terms of the three null hypotheses, beginning with the one hypothesis that was rejected. Following this, general comments on the experimental data will be made.

The Analysis of Variance indicates that age was the only significant main effect (see Table I). The Analysis of Variance for the Simple Effects of Age indicates that rotation at each exposure time was significantly influenced by the three ages used in this experiment (see Table IV). Through the examination of the t tests for age, a more detailed understanding of the mean differences can be obtained.

Prior to the discussion of the t tests it should be noted that some of the cell variances are not homogeneous. It was formerly maintained that in order to use the t tests there should be homogeneity of variance. However, as Hays states,

[...] most modern authorities suggest that testing homogeneity of variance is not worth the trouble involved. In circumstances where it is needed most (small samples), the tests for homogeneity are poorest. Furthermore, for samples of equal size relatively big differences in the population variances seem to have relatively small consequences for the conclusions derived from the t tests.<sup>1</sup>

The t tests indicate that it was only at the "no limit" exposure time that the mean rotation scores of the eleven and fourteen year age groups differed significantly. At the ten second and one second exposure times the t tests between the eleven and fourteen year age groups yielded negative results. The mean rotation scores of the eleven year age group did not follow the same pattern as did the mean rotation scores of the other two age groups (see Figure 1). It is possible that the eleven year age group contained a sampling error. The cell standard deviations indicate that the results of this age group at ten second limit of exposure time were more homogeneous than were the results of the other age groups (see Table III). Also, in the analysis of the retest data it was noted that the standard deviation of the eleven year old group at ten seconds of exposure time was very high--26.93. In the original data the standard deviation of this cell was 8.65. The discrepancy in these results tends to support the possibility that this group

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<sup>1</sup> William L. Hays, Statistics for Psychologists, New York, Holt, 1963, p. 322.

contained children whose performances were more inconsistent than those of the other subjects in the samples used.

With the exception of the one second exposure time, the mean rotation scores of the eight year age group differed significantly from those of the eleven and fourteen year age groups. At the one second level, the variances were so great that the t test results were not significant. These results indicate that in this study, developmental factors influenced rotation scores between eight and eleven years. The developmental factors were much less influential between eleven and fourteen years of age.

On the basis of Fabian's<sup>2</sup> and Koppitz's<sup>3</sup> findings it was expected that age would not be a significant factor after seven years. Because of the apparent discrepancy between the results of this study and the findings of Fabian and Koppitz, a more intensive examination of their studies seemed warranted.

As mentioned previously, there is some doubt about the validity of Fabian's results because of his inadequate experimental design. Also, when his results are examined

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2 A.A. Fabian, "Vertical Rotation in Visual-motor Performance - Its Relationship to Reading Reversals", Journal of Educational Psychology, Vol. 36, No. 3, March 1945, p. 129-154.

3 Elizabeth Munsterberg Koppitz, The Bender Gestalt Test for Young Children, New York, Grune and Stratton, 1964, 195 p.

carefully, it can be noted that six per cent of his eight year and eight and one half year old subjects rotated one or more designs and ten per cent of the nine year olds rotated designs. Of these rotations ninety-four per cent were what Fabian termed 'vertical rotations'.<sup>4</sup> In his conclusions, Fabian claimed that the tendency to rotate horizontally directed configurations to the vertical position "is a developmental phenomenon which is gradually corrected as the child matures, but does not disappear until he is seven or eight years of age."<sup>5</sup> However, his results indicated that even in his oldest age group, nine years, rotations were still manifested. The fact that the nine year olds rotated more than the eight year olds suggests that even by the age of nine years the rotation phenomenon is still not stabilized.

Koppitz maintained that after seven years of age rotation is no longer expected in the normal population. She defined rotation as a forty-five degree deviation from the stimulus axis and allowed the subject to "adjust the position of the paper to suit himself."<sup>6</sup> It can be noted that in contrast to Koppitz's studies, the present study did not allow for changes in the position of the paper and measured

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<sup>4</sup> Fabian, Op. Cit., p. 139.

<sup>5</sup> Ibid., p. 151.

<sup>6</sup> Koppitz, Op. Cit., p. 15.

rotation in terms of actual degrees. It is suggested that when rotation is defined as precisely as it was in this study, age beyond seven years is still a significant variable influencing rotation.

Since Fuller and Laird<sup>7</sup> used a sample of normal children in their standardization of the MPD, it seemed advisable to compare Fuller and Laird's rotation scores for this population to the rotation scores at "no limit" in this study. Fuller and Laird's mean rotation score was 14.89 degrees<sup>o</sup> and the mean rotation score for the "no limit" group in this study was 33.61 degrees.

The difference in these rotation scores could be accounted for by two factors. Fuller and Laird's mean age was 13.22 years. The mean age of the sample at "no limit" on exposure in this study was younger--11.60 years. The results of this study indicate that younger children rotate more than older children. Also, the stimulus in this experiment was presented on a vertical screen and reproduced on a horizontal plane. In Fuller and Laird's study the stimulus was presented on a horizontal plane and reproduced on a horizontal plane. In this study the subjects were required to make a perceptual shift from the vertical to the horizontal

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7 Gerald B. Fuller and James L. Laird, "The Minnesota Percepto-Diagnostic Test", Special Monograph Supplement, No. 16, Journal of Clinical Psychology, January 1963, 32 p.

8 Ibid., p. 17.

plane and this was not necessary in the research by Fuller and Laird. It may be that when a perceptual shift is required there are fewer directional cues available and rotation could increase.

The result of the interaction effect of age and exposure time on rotation was so low that it can be stated that within this design there was no interaction between age and exposure time in terms of rotation. It was noted that as age increased variance at the four exposure times decreased. When age increased there was improved performance on the test and the rotation scores became smaller. These reduced scores provided less opportunity for variability under the experimental conditions.

The statistical findings indicate that although there was a trend toward increased rotation when exposure time was reduced the increases were not significant. The most outstanding result of reduced exposure time was increased variability (with the exception of the eleven year old group which did not follow the pattern of the other two age groups).

A variety of factors could account for this increase in variability. This study has indicated that even after seven years, age is still an important variable in rotation. It is possible that the age range in each group (eleven months) was too wide an age span to provide for homogeneity within the groups and that when exposure time was reduced the heterogeneous factors in the groups became more pronounced.

Studies on after-image<sup>9,10</sup> have indicated that there is considerable individual difference in after-image. This variable was not controlled in the present design and could have become increasingly more important as exposure time was reduced.

The samples of exposure times used could also have been a factor contributing to the variability in the results. Since the influence of reduced exposure time on the reproduction of designs has experienced so little experimental investigation the exposure times in this study were selected arbitrarily. It is possible that other exposure times could have been more appropriate and would have produced less variation in the results.

A few suggestions have been made as to the possible factors contributing to increased variance in performance when exposure time was reduced. However, further experimentation is needed to gain an understanding of this phenomenon.

A few observations on the data of this study might produce fruitful hypotheses for further research. Fuller and Laird have commented that "Sometimes subjects in reproducing

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9 Joseph B. Cooper, "Some Characteristics of Negative After-Images", Journal of General Psychology, Vol. 39, 2nd Half, October 1948, p. 217-220.

10 Francis A. Young, "Studies of the Projected After-Image: I. Methodology and the Influence of Varying Stimulus Times", Journal of General Psychology, Vol. 46, First Half, January 1952, p. 73-86.

the designs in cards 1, 3 and 5 do not rotate but the circle and diamond are separated from one another."<sup>11</sup> This separation of circle and diamond was noted in the data. It decreased as age increased and increased as exposure time was reduced. Bender has suggested that in terms of Gestalt principles, "The two closed figures [...] are experienced as two contingent 'gute Gestalten'" that are "[...] so dominant that subjects commonly separate them, the contingency of the two figures proving thereby to be an unimportant part of the visual motor experience."<sup>12</sup> It would appear from this study that this phenomenon is related, in part, to developmental factors.

It was also noted that the outline of the background shape was drawn on one or more of the designs by twenty-two of the 8 year olds, five of the 11 year olds, and three of the 14 year olds. Of these thirty subjects, 24 drew the background shape on only those designs containing the dot configurations. This phenomenon has not been noted in other studies using the MPD.

It is suggested that the tendency to draw the shape of the background may have resulted partly from the fact that the stimuli (cards) were projected on a screen and the outline of the white background shape was quite outstanding. Also, the test instructions differed from the usual instructions on

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<sup>11</sup> Fuller and Laird, Op. Cit., p. 25.

<sup>12</sup> Tolor and Schulberg, Op. Cit., p. xi.

the MPD which refer directly to figure and ground. "I am going to show you six cards, one at a time. Each card contains a figure. Copy the figure on this paper. [...]"<sup>13</sup> The instructions in this study did not refer directly to figure and background.

The tendency to draw the background on only those items that contained the dot configuration suggests that the dot configuration is less independent of the background than the linear configuration of test items 1, 3 and 5. The dot design is based on the Gestalt principle of proximity of parts<sup>14</sup> and the other design is made up of two closed, contingent figures, each of which constitutes a "gute gestalt".<sup>15</sup> It would appear from this study that Gestalt Designs made up of closed, "gute gestalt", exert a stronger influence on subjects than do those that are based on the principle of the proximity of parts.

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13 Fuller and Laird, Op. Cit., p. 20.

14 Laretta Bender, A Visual Motor Gestalt Test and Its Clinical Use, New York, American Orthopsychiatric Association, 1938, p. 5.

15 Ibid., p. 4.

## SUMMARY AND CONCLUSIONS

The need to scientifically investigate Bender's formulations concerning the visual-motor functioning of non-pathological groups gave rise to the present study. According to Bender, inaccuracies in the reproduction of Gestalt Designs decrease as children mature and increase as the exposure time of the stimulus is reduced. This study was designed to investigate these statements by Bender in one aspect of visual-motor functioning--rotation (defined as an axial turning of a reproduced design from its position in the original stimulus).

On the basis of previous investigations it was expected that by eight years of age rotation would not be influenced by developmental factors, but that rotation would increase when the exposure time of the stimulus was reduced.

It was hypothesized that neither of the independent variables, age and exposure time, nor the interaction of the two would influence rotation (the dependent variable).

The subjects in the study were 180 "normal" children. Sixty children were selected at each of the following age levels: eight years, eleven years and fourteen years. Fifteen children from each age level reproduced the Gestalt Designs of the MPD under one of the following conditions of exposure time: "no limit", ten seconds, five seconds and one second.

The results were analysed by Analysis of Variance. The results indicated that age was the only variable that significantly influenced rotation. As age increased, rotation at each exposure time decreased. When exposure time was reduced there was increased variability within groups rather than a consistent increase in rotation.

This study failed to validate previous findings that reduced exposure time results in increased rotation. However, the results have established two important facts. Within this design: a) age beyond seven years is still a significant variable influencing rotation, b) reduced exposure time results in increased variability in rotation. These findings suggest two important areas for further research.

Further investigation should be made into the developmental aspects of rotation using the standard test procedure of a test such as the MPD.

Many hypotheses can be formulated concerning the factors contributing to increased variability in rotation as exposure time is reduced. An experimental design in which all subjects are exposed to each of the treatment conditions might eliminate some of the variability due to individual differences. (Each subject would be his own control.) An experimental design of this type would have to take into consideration that the practice effect may be high because the MPD is made up of only two designs. Also, because of the

apparent simplicity of the test, the subjects may become disinterested with repeated exposure to the test. Comments made by subjects in this study when retest data were being obtained suggested that even with two presentations of the test material they were becoming disinterested.

Because the influence of group and screen administration on the results of the MPD has not yet been investigated, a duplication of this study using individual administration and a tachistoscope might produce more significant results in terms of the effect of exposure time on rotation. Perhaps a tachistoscope could be designed so that the designs would be presented on a horizontal plane. This would eliminate the need for a perceptual shift on the part of the subjects.

The age variable was a significant factor in this study and became less significant as age increased. Further research on the influence of exposure time on rotation in older age groups might provide more significant results because the developmental factor would not influence the results to the same extent.

The exposure times selected may not have been the "right" ones and other exposure times might influence rotation significantly.

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A presentation of the Bender-Gestalt with case illustrations of its clinical usefulness. Of particular interest were her descriptions of the development of the visual-motor functioning of children and her discussion of the results of the tachistoscopic presentation of the Gestalt Designs.

Fabian, A.A., "Vertical Rotation in Visual-Motor Performance - Its Relationship to Reading Reversals", Journal of Educational Psychology, Vol. 36, No. 3, March 1945, p. 129-154.

Although poorly designed experimentally, this was the first attempt to obtain normative data on the developmental factors influencing rotation and to relate the findings to reading difficulties. His findings that limited exposure time resulted in increased rotation provided the basis for the present study.

Fuller, Jerry E. 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.

A well designed study that indicated some stimulus factors of Gestalt Designs that influence rotation.

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The Developmental Bender Scoring System and its implications in terms of differential diagnosis are presented. Of value were her findings on the developmental factors involved in rotation.

Tolor, Alexander and Herbert C. Schulberg, An Evaluation of the Bender-Gestalt Test, Springfield, Illinois, Thomas, 1963, xxiii-229 p.

A thorough review of the English literature on the Bender-Gestalt until 1961. The critical evaluation of the research points out the need for the validation of theoretical formulations and more methodologically sound experimental designs.

APPENDIX 1

ABSTRACT OF

The Effect of Age of Children and Exposure Time of  
Stimulus on Rotation in a Visual-Motor Task

APPENDIX 1

ABSTRACT OF

The Effect of Age of Children and Exposure Time of Stimulus on Rotation in a Visual-motor Task<sup>1</sup>

The need for scientifically evaluating some of the theoretical formulations of Lauretta Bender provided the basis for the present study. Bender has suggested that within the normal child population the accuracy in the reproduction of Gestalt Designs is determined by developmental processes and when the time for viewing Gestalt Designs is limited more developmentally primitive drawings are produced. Fabian's attempt to validate these formulations in terms of one aspect of visual-motor functioning (rotation) lacked scientific validity. This study was designed to cross-validate Fabian's study and to investigate the influence of age and reduced exposure time on the rotation of Gestalt Designs by children.

The subjects were 180 normal children. Sixty children were selected at each of the following age levels: eight years, eleven years and fourteen years. Fifteen children from each age level reproduced the Gestalt Designs of the Minnesota Percepto-Diagnostic Test under one of the following conditions

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<sup>1</sup> Margaret E. Gillespie, Master's thesis presented to the Faculty of Psychology and Education of the University of Ottawa, 1966, viii-43 p.

of exposure time: "no limit", ten seconds, five seconds and one second.

The results of the experiment were analysed by means of Analysis of Variance and indicated that age was the only significant variable influencing rotation. As age increased rotation decreased at all levels of exposure time. Previous research, including Fabian's, had indicated that beyond seven years of age rotation was no longer influenced by developmental factors. However, in the former studies rotation was not defined as precisely as it was in this study. The results of this experiment suggest that until fourteen years of age, developmental factors could influence rotation. The results failed to validate Fabian's findings that reduced exposure time results in increased rotation. Instead, the results suggested that reduced exposure time increased variability in rotation scores.

It was concluded that the developmental factors in rotation should be more extensively evaluated and that the reduction of exposure time of stimulus in visual-motor Gestalt tasks gives rise to many variables that were not controlled in this experimental design.