THE RELATION BETWEEN THE BHATIA PATTERNS TEST, PORTEUS MAZE TEST, GRADE SCORES AND A GROUP MEASURE OF ACHIEVEMENT

by

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B.A., University of British Columbia, 1957

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF Master of Arts in the Department of Psychology

We accept this thesis as conforming to the required standard

THE UNIVERSITY OF BRITISH COLUMBIA

April, 1959
The purpose of this study was to explore some of the possibilities of a promising new culture-free, individual performance test of intelligence. This test, the Bhatia Patterns Test, was originally designed for a test battery that was used on Indian school children. The problem of this study was to determine if the Patterns Test had any value in a North American setting. One hundred and sixty-five pupils were tested with the Bhatia Patterns Test and the Porteus Maze Test. In addition, the I.Q. scores of the California Short Form Test of Mental Maturity, the scores of the Stanford Achievement Intermediate Battery (Form K) and the grade scores of the pupils were collected. More specifically, this study wished to ascertain whether there were any differences between sexes with the Patterns Test, whether the Patterns Test and the Maze Test correlated significantly, whether the Patterns Test was related to a standardized group achievement measure, and whether the Patterns Test was related to the pupils' grade scores.

One hundred and sixty-five school pupils were chosen at random from grades four, five and six from five
Vancouver elementary schools. The subjects were given
the Patterns Test and the Maze Test in a counterbalanced
design to determine whether either of the tests had an
effect upon each other. The counterbalanced design was
analyzed by a two by two latin square. In addition, all
the scores were correlated with each other to determine
what relationships existed between the various measures.

It was concluded that there were no sex dif-
ferences among the scores of the subjects. The Bhatia
Patterns Test and the Porteus Maze Test did not correlate
significantly. The Patterns Test correlated higher with
a standardized achievement test than did a group measure
of intelligence. The Patterns Test did not correlate
significantly with the pupils' grade scores.
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Date **April 13, 1959**
The writer wishes to express his indebtedness to Dr. R.F. Sharp, Superintendent of Schools, Dr. S.A. Miller, Director of Research and Special Services and Dr. E.N. Ellis, Assistant in Research and Testing in arranging for the availability of schools and subjects in the Vancouver School District. Profound thanks are due to the principals and staffs of the schools for their sincere co-operation toward this study. Finally, the writer is extremely grateful to his advisor, Dr. D.T. Kenny, for his helpful criticism and general guidance throughout the course of this thesis.
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CHAPTER I
INTRODUCTION AND THE STATEMENT OF THE PROBLEM

While the need for performance scales as a measure of intelligence has long been recognized and though their application to clinical cases has been extensive, comparatively little exploratory research has been conducted on the development and evaluation of new performance tasks. The major research trend with performance tests has been to combine existing single tests into a battery and to standardize the battery on a new sample. As Cronbach (1949, p.161) has so cogently expressed, "a limited number of tasks have been used repeatedly in different scales, with or without adaptation."

C.M. Bhatia (1955) devised a new test to serve as part of a test battery for testing school children in India. This new test, the Pattern-Drawing Test or Patterns Test, appeared to show some promise in the field of mental measurement. Bhatia (1955) suggested that the Patterns Test could be utilized as a culture-free test since only the verbal instructions (see Appendix A) needed to be translated into the parent language of the subject.

The Bhatia Patterns Test is an individual test where the subject is shown a pattern (see Appendix B) on a card. The subject is then asked to draw the pattern on a blank sheet of paper without lifting his pencil from
the paper and without repeating any line he has drawn. The patterns are given to the subject in an order of increasing difficulty. The test is scored on a time basis with a time limit which varies with the different patterns. The test is stopped when any two patterns are failed in succession.

The desirable features of the Patterns Test are many. It involves little in the way of special equipment and it is easily administered and scored. Construction of a comparable form would pose little difficulty and the test can be easily extended to more difficult levels. A particularly strong point is the latter. In addition, the Patterns Test should prove useful to the clinician since it is individually administered and it allows the subject to be observed while the subject is attempting to produce a pattern.

The problem in this present study was to explore some of the possibilities of the Bhatia Patterns Test. Bhatia devised his Patterns Test for use on school children and he suggested that the test was a culture-free test. Therefore, a number of elementary school children were tested with the Patterns Test and the results were related to various other measures to determine whether the Bhatia test had any value in a North American setting.

Bhatia's examiners found they had to exercise caution when children were tested in India. The inhabitants
of the villages were reluctant to allow a child to be tested by some stranger. The examiners usually tested the subjects outdoors in such a position that every move was viewed by the elders. In this way the examiners showed the villagers that no harm came to the child. As a result of the extreme conditions under which the Indian examiners gathered their data, it was impossible to collect Patterns Test scores upon other than male subjects. No data have been forthcoming upon the use of the Patterns Test with female subjects. In this present study 87 male and 78 female subjects were chosen to determine if there were any sex differences within the test. Therefore, the first hypothesis of this study was: the Bhatia Patterns Test will be equally satisfactory for female subjects as for male subjects.

The Patterns Test showed a high factor loading on a general factor of intelligence (.65) that Bhatia obtained in a factor analysis of a battery of intelligence measures. The Stanford-Binet (Form L) also correlated highly (.61) with this first order factor. The correlation between the Stanford-Binet (Form L) mental age and the Patterns Test was .46 when the effects of chronological age were held constant by partial correlation.

The Indian test battery was entirely devised by Bhatia with the exception of two of the subtests, the Alexander Passalong Test and the Kohs Block Design Test. These two subtests were used in a slightly modified form.
The Patterns Test correlated well \( r = .53 \) with the Block Design Test. The correlation between the Patterns Test and the Passalong Test was slightly lower \( r = .43 \).

Bhatia stated (1955, p. 24) that his test contained a spatial factor or \( k \) component. Also, the Patterns Test appeared to require some planning ability in order to be completed satisfactorily. Porteus (1950) purported to measure planning ability with his Maze Test and the Maze Test appeared to contain a spatial factor. In addition, Porteus stated that his Maze Test could be called a test of intelligence (1950, p. 12). He cited numerous studies that have found a relationship between the Maze Test and other measures of intelligence. Louttit and Stackman (1936) summarized many previous studies to show a substantial relationship between the Maze Test and the Binet Test. In this present study a number of subjects were given both the Patterns Test and the Maze Test to determine if there was a common element within the two tests. Therefore, the second hypothesis in this study was: the Bhatia Patterns Test will correlate significantly with the Porteus Maze Test.

The Porteus Maze Test is an individual test where the subject is shown a maze on a paper. The subject is then asked to take a pencil and trace his way out of the maze without lifting his pencil from the paper and without crossing any line of the maze. The mazes are
given to the subject in an order of increasing difficulty. A mental age is obtained from the number of correctly traced mazes.

Since the subjects of this present study were school children, the I.Q. scores of the California Short Form Test of Mental Maturity (CSFTMM) were collected as were the scores of the Stanford Achievement Intermediate Battery, Form K (SAIB) in order to determine whether the Patterns Test bore any relation to these two group measures. Therefore, the third hypothesis of this study was: the Bhatia Patterns Test will predict standardized achievement scores as readily as a group measure of intelligence.

The CSFTMM is a group aptitude test battery which derives scores under five headings: memory, spatial relationships, logical reasoning, numerical reasoning and vocabulary. The test yields ratio I.Q.'s for language, non-language and total scores. The SAIB is a group achievement battery which contains nine tests: paragraph meaning, word meaning, spelling, language, arithmetic reasoning, arithmetic computation, social studies, science and study skills. The SAIB is primarily a power battery. Partial battery scores such as Reading and Arithmetic may be obtained. Only the total score I.Q.'s are reported for both the CSFTMM and the SAIB in this present study.

Traxler (1955) obtained a high correlation
(r = .84) between the CSFTMM and total grade marks. His subjects were elementary school children. Cowne (1954) tested grade eight pupils with both the CSFTMM and the SAIB. He obtained a correlation (r = .80) between the CSFTMM and the SAIB Reading. The CSFTMM and the SAIB Arithmetic correlated slightly lower (r = .73). Sheldon and Manolakes (1954) correlated (r = .70) the Stanford-Binet (Form L) and the CSFTMM obtained from 422 elementary school pupils.

When working with children, grade scores frequently have been utilized as a criterion for various measures of intelligence. The grade scores of these subjects were gathered to determine if the Patterns Test related to them. Therefore, the fourth hypothesis of this study was: the Bhatia Patterns Test will predict the grade scores of elementary school pupils.

In summary, the explicit hypotheses to be tested in this study can be stated as follows:

1. The Bhatia Patterns Test will be equally satisfactory for female subjects as for male subjects;
2. The Bhatia Patterns Test will correlate significantly with the Porteus Maze Test;
3. The Bhatia Patterns Test will predict standardized achievement scores as readily as a group measure of intelligence; and
4. The Bhatia Patterns Test will predict the grade scores of elementary school pupils.
CHAPTER II
PROCEDURE

Five schools of the Vancouver School System were chosen by Dr. E.N. Ellis of the Department of Research and Special Services as a representative sample of the schools of the city of Vancouver. From these five schools, 165 male and female subjects were obtained from grades four, five and six. The total number of subjects divided into 87 male and 78 female subjects. Approximately equal numbers of subjects were selected from each of the three grades. No distinction was made between male and female subjects and no attempt was made to obtain any sex ratio. The subjects were chosen from each grade on a random basis by placing the name of each student in the grade in a container and then drawing enough names to have an adequate supply of pupils for the time allowed to test them. Two restrictions were placed upon the testing of a pupil; the pupil must have previously taken the CSFTMM and he must have begun his school career in the English language.

The subjects were given the Patterns Test and the Maze Test in a counterbalanced order, that is, subject number one was given the Maze Test followed by the Patterns Test and subject number two was given the Patterns Test followed by the Maze Test. This arrangement was carried through the 165 subjects with the odd numbered subjects
receiving the Porteus Test followed by the Bhatia Test and the even numbered subjects receiving the Patterns Test followed by the Porteus Test.

The counterbalanced design was used to determine whether either of the tests had any effect upon the scores of the other test. Also, this design tends to balance any practice effects that may be transferred from one test to the other.

The Porteus Maze Test was given to the subjects by following the exact (1950) instructions Porteus gave for the test. No deviations from these instructions were allowed otherwise the test findings could not be validly correlated with the other measures and the conditions for any interpretations would differ from those of Porteus. In addition, only the quantitative scoring procedure of the Porteus Test was utilized since the qualitative scoring procedure was irrelevant to the purposes of this study.

No deviations from the exact instructions of Bhatia were allowed for the Patterns Test. Since Bhatia suggested that his Patterns Test was a culture-free test, the identical procedure was followed except that the instructions were given in English.

The final grade scores for the year were gathered for all the subjects. These grade scores were the letter grades (A, B, C, S or U) the pupils received on their final report card. The grade scores were derived by first com-
puting the mean for the scores of nine different ability areas such as Science, Arithmetic and Spelling for each pupil. Secondly, the means for the entire grade were placed in a frequency distribution. Then, the means were awarded letter grades where the highest 10% of the grade received an A, the next highest 20% received a B, the next 40% of the group received a C, the next 20% of the pupils received an S, and the final 10% received a U. For this present study the grade scores were assigned numerical values from five to one which correspond to the letter grades from A to U.

The I.Q. scores for the CSFTMM were also obtained. In addition, the scores for the SAIB were collected for all those subjects who were in grade six.
CHAPTER III
THE RESULTS AND THEIR STATISTICAL TREATMENT

Hypothesis 1: The Bhatia Patterns Test will be equally satisfactory for female subjects as for male subjects.

The Bhatia study only utilized male subjects for the standardization of the test battery. Since female subjects were used in this experiment, it was necessary to determine if there were any differences between male and female subjects before any further analysis of the Patterns Test could be made. In addition, it was necessary to ascertain if there were any differences between the five schools chosen for the study. Appendix Table 1 presents the mean scores on the Bhatia for the different schools and the two sexes. Analysis of variance shows there are no significant differences between the sexes ($F = 1.75$, $P > .05$) or between the schools ($F = 2.31$, $P > .05$). The former finding indicated that the first hypothesis of the present study was confirmed.

The Porteus Maze Test was analyzed in the identical fashion. Appendix Table 2 shows the mean scores on the Porteus for the different schools and the two sexes. Analysis of variance again shows there are no significant differences between the sexes ($F = 2.07$, $P > .05$) or between the schools ($F = 1.90$, $P > .05$).

The many sources of differences that may arise
from a counterbalanced design were analyzed by the use of Grant's (1949) two by two latin square. These findings are presented in Appendix Table 3. The only significant difference found was a difference between the two tests (\( F = 153.96, P < .01 \)). The analysis showed that no differences arose as a result of the counterbalanced design. Neither the Patterns Test nor the Maze Test gave a practice effect that was transferred during the test session.

In order to test the remaining three hypotheses, the Bhatia Test, the Porteus Test, the CSFTMM, the SAIB and the grade scores were all correlated with each other by product-moment correlation methods. Table 1 shows the results of these correlations.

**Hypothesis 2:** The Bhatia Patterns Test will correlate significantly with the Porteus Maze Test.

The correlation between the Patterns Test and the Maze Test was .14. Since this was not a significant correlation, hypothesis two was not supported.

**Hypothesis 3:** The Bhatia Patterns Test will predict standardized achievement scores as readily as a group measure of intelligence.

The correlation between the Patterns Test and the CSFTMM was .30. This was significant at the .01 level of confidence. The correlation between the Patterns Test and the SAIB was .35. This was significant at the .05 level of confidence. The correlation between the CSFTMM and the
TABLE 1
PRODUCT-MOMENT CORRELATIONS BETWEEN THE BHATIA TEST, PORTEUS TEST, CSFTMM, SAIB AND GRADE SCORES

<table>
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<tr>
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<th>Bhatia</th>
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<th>CSFTMM</th>
<th>SAIB</th>
<th>Grade Scores</th>
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<tr>
<td>Bhatia</td>
<td></td>
<td>.14</td>
<td>.30 **</td>
<td>.35 *</td>
<td>.21 **</td>
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<tr>
<td>Porteus</td>
<td></td>
<td></td>
<td>.19 *</td>
<td>.24</td>
<td>.07</td>
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<td>.55 **</td>
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<td>SAIB</td>
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<td></td>
<td></td>
<td></td>
<td>.49 **</td>
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<tr>
<td>Grade Scores</td>
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</tbody>
</table>

* significant at the .05 level of confidence
** significant at the .01 level of confidence
SAIB was .22. This was not a significant correlation. While the present results did not support the third hypothesis, they actually indicated that the Bhatia was a better predictor of achievement than was a group test of intelligence.

**Hypothesis 4:** The Bhatia Patterns Test will predict the grade scores of elementary school pupils.

The correlation between the Patterns Test and the grade scores was .21. Since this correlation was significant at the .01 level of confidence, the fourth hypothesis of this study was upheld.

The data of this study also yielded some additional interesting information on how the various variables intercorrelated and how they combined when placed in a multiple correlation formula. The correlation between the Maze Test and the CSFTMM was .19. This was significant at the .05 level of confidence. The correlation between the Maze Test and the SAIB was .24 and the correlation between the Maze Test and grade scores was .07. Neither of these correlations were significant. The correlation between the CSFTMM and grade scores was .55 which was significant at the .01 level of confidence. The correlation between the SAIB and grade scores was .49 which also was significant at the .01 level of confidence.

Since the Bhatia Patterns Test had been devised for and used in a test battery, it appeared that multiple correlation procedures may have been of some value to this
exploratory study. The Patterns Test and the CSFTMM were combined in an attempt to predict the SAIB. The resulting multiple correlation coefficient was .37. The multiple correlation coefficient was .49 between grade scores and a combination of the Patterns Test and the SAIB. When the CSFTMM and the Patterns Test were combined to predict grade scores, the multiple correlation coefficient yielded .55 and the combination of the CSFTMM and the SAIB produced a multiple correlation coefficient of .67 in an attempt to predict grade scores. A four-fold multiple correlation between grade scores and a combination of the CSFTMM, the SAIB and the Patterns Test resulted in a multiple correlation coefficient of .67. All the reported multiple correlations were significant at the .01 level of confidence.
CHAPTER IV
DISCUSSION

Because of the extreme difficulty of testing female subjects under local Indian conditions, Bhatia confined his study to male subjects between the ages of 11 and 16 years. Therefore, he has made no comment on whether there may or may not be differences between the sexes with the Patterns Test. Since 78 of the 165 subjects within this present study were females, it was necessary to determine if sex was a factor with the Patterns Test. The statistical analysis showed there were no differences between the male and the female Patterns Test scores. Therefore, sex of the subject does not appear to be an influencing factor. Such a finding supports the first hypothesis of this study.

The Patterns Test appeared to require some planning ability which Porteus purported to measure with the Maze Test. The analysis of the two tests, however, showed there was not a significant correlation \( r = .14 \) between the two tests. Therefore, the second hypothesis of the study was not confirmed.

Bhatia obtained a high factor loading on a general factor of intelligence (.65) in a factor analysis of a battery of intelligence measures. The Stanford-Binet (Form L) also correlated highly (.61) with this first order factor.
The correlation between the Stanford-Binet (Form L) mental age and the Patterns Test was .46. However, in this study the correlation between the Patterns Test and the CSFTMM \( (r = .30) \) was not high although it might be increased by a greater number of patterns within the Patterns Test. The correlation between the Patterns Test and the SAIB was .35. Neither the CSFTMM nor the SAIB correlation with the Patterns Test showed the relationship that Bhatia obtained correlating the Patterns Test with the Stanford-Binet \( (r = .46) \) which indicated that the Patterns Test was not as satisfactory a predictor with these two group measures as it was with the individual Stanford-Binet. However, the Patterns Test, on the basis of the correlation with the SAIB, appeared to be testing some factor or factors in common with the group achievement test. Also, the Patterns Test, on the basis of its correlation with the CSFTMM, appeared to be measuring some common factors with the group intelligence test. Therefore, since the Patterns Test correlated significantly with each of these group measures and since each of the correlations was higher than the correlation between the two group measures \( (r = .22) \), the Patterns Test may have some value if it is used as one of a number of tests within a test battery just as Bhatia used it. The third hypothesis was not supported by the results of these correlations but the correlations actually indicated that the Patterns Test was a better predictor of the achievement test than was the group test of intelligence.
The Porteus Maze Test has also been utilized as a measure of intelligence. It showed less of a relationship with the two group measures than the Bhatia Test showed. The correlation between the Maze Test and the CSFTMM was just significant ($r = .19$) while the correlation between the Maze Test and the SAIB was not significantly different from zero which indicated that the Maze Test had less of a predictor value with the two group measures than did the Patterns Test. However, one factor that may have been operating on the Maze Test was the amount of practice effect or test sophistication displayed by a majority of the pupils examined. Many of the comic books that these children read had a "puzzle page". This puzzle page usually contained a maze of varying degrees of difficulty but very similar in form to a Porteus Maze.

The relationship between the various tests and the grade scores of the subjects was a critical factor because grade scores are frequently utilized as a test criterion. Both of the group measures correlated satisfactorily with the grade scores. The Maze Test showed no relationship with the grade scores since the correlational figure did not differ significantly from zero ($r = .07$). The Patterns Test showed a slight relationship with the grade scores ($r = .21$) but again this correlation was not sufficient to claim any great predictive value for the Patterns Test. Such a finding does, however, lend support to
the fourth hypothesis.

None of the three-fold multiple correlations gave a contribution except the correlation between the grade scores, the SAIB and the CSFTMM which correlated .67. When the Patterns Test was included with the three previous variables to form a four-fold multiple correlation, the correlation remained the same ($r = .67$). This suggested that the Patterns Test contributed nothing to this group relationship although, as previously stated, the Patterns Test may have some value as a test within a test battery since it correlated higher with each of the group measures than the group measures correlated with each other.
CHAPTER V
SUMMARY AND CONCLUSIONS

The Bhatia Patterns Test has been given to a number of subjects in order to explore some of the possibilities of the test in the area of mental measurements. Since the Patterns Test appeared that it might be measuring a common factor with the Porteus Maze Test, the Maze Test was also given to the subjects by a counterbalanced design. Bhatia's Patterns Test results were reported for male subjects only. This present study used female as well as male subjects to determine if there were any differences due to the sex of the subjects. The CSFMM, the SAIB, the grade scores and the age of the subjects were collected as criterion measures.

More explicitly, the hypotheses to be tested in this present study were as follows:

1. The Bhatia Patterns Test will be equally satisfactory for female subjects as for male subjects;

2. The Bhatia Patterns Test will correlate significantly with the Porteus Maze Test;

3. The Bhatia Patterns Test will predict standardized achievement scores as readily as a group measure of intelligence; and

4. The Bhatia Patterns Test will predict the grade scores of elementary school pupils.
It was concluded that there were no sex differences among the scores of the subjects for the Patterns Test. On the basis of this finding, the first hypothesis was validated.

Although the Patterns Test appeared to need some planning ability which Porteus purported to measure with his Maze Test, there was no evidence of any common factor between these two measures. Thus, the second hypothesis was vitiated.

The correlation reported by Bhatia between the Patterns Test and the Stanford-Binet was not duplicated when a group measure of intelligence was used as a criterion. The correlations between the Patterns Test and each of the group measures were higher than the correlation between the two group measures. On this basis the Patterns Test showed that it may have some value as one of a series of measures within a test battery. These results showed the third hypothesis was not supported. However, the results indicated that the Patterns Test was a better predictor of the achievement test than was the group test of intelligence.

The correlation between the Bhatia and the grade scores was significant. Thus, the fourth hypothesis was confirmed. However, the correlation was too low for any practical purposes of prediction. On the other hand, its correlation with a standardized achievement test did indicate that it may be of some limited value in predicting
achievement test scores of pupils, particularly those scoring either extremely high or extremely low on it.
References


APPENDIX A

INSTRUCTIONS FOR THE BHATIA PATTERNS TEST
INSTRUCTIONS FOR THE BHATIA PATTERNS TEST

1. There are eight patterns of increasing difficulty from the 1st to 8th.

2. Give the following instructions to the subject:
   'Here is paper and a pencil. I shall show a figure to you.' Place a card before the subject. Let the card be so displayed that the number of the card appears at the top before the subject. 'Now make a figure like this without repeating your lines and without lifting your pencil when once you have started drawing.' The card should remain in full view of the subject throughout.

3. Let the subject try successive patterns. Stop when failure is recorded twice in succession.

4. Provide a plain white sheet of paper to the subject on which to draw the patterns. Successive patterns may be drawn on the same sheet as long as there is room.

5. Allow a maximum of two minutes for each of the first four patterns. Allow a maximum of three minutes for patterns Nos. 5 to 8. The subject may make as many attempts on the paper as he likes within the time limit.

6. Demonstrate the first pattern, if necessary. It is only meant to give the subject confidence and facility in drawing.
7. When a failure occurs in one of the patterns, demonstrate this, but do not let the subject try this pattern again. Pass on to the next. Stop when failure is recorded in two successive designs.

8. Watch the subject while he is drawing. If he repeats a line or lifts his pencil, remind him of the conditions. Ask him to commence after proper thought. If he makes a drawing wrong, cross it out and ask him to start afresh. Encourage him to try as many times as he likes within the time limit before you record a failure in a particular pattern.
APPENDIX B

THE EIGHT PATTERNS OF THE BHATIA PATTERNS TEST
FIGURE 1
THE FIRST PATTERN OF THE BHATIA PATTERNS TEST

FIGURE 2
THE SECOND PATTERN OF THE BHATIA PATTERNS TEST
FIGURE 3
THE THIRD PATTERN OF THE BHATIA PATTERNS TEST

FIGURE 4
THE FOURTH PATTERN OF THE BHATIA PATTERNS TEST
FIGURE 5
THE FIFTH PATTERN OF THE BHATIA PATTERNS TEST

FIGURE 6
THE SIXTH PATTERN OF THE BHATIA PATTERNS TEST
FIGURE 7
THE SEVENTH PATTERN OF THE BHATIA PATTERNS TEST

FIGURE 8
THE EIGHTH PATTERN OF THE BHATIA PATTERNS TEST
APPENDIX C

MEANS AND STANDARD DEVIATIONS OF THE
BHATIA PATTERNS TEST AND THE PORTEUS
MAZE TEST FOR SCHOOLS AND SEX
<table>
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<td>Female</td>
<td>11.88</td>
<td>3.68</td>
</tr>
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</table>
TABLE 2  
MEANS AND STANDARD DEVIATIONS OF THE  
PORTEUS MAZE TEST FOR SCHOOLS AND SEX

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SEX</th>
<th>MEAN</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>12.73</td>
<td>3.38</td>
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<tr>
<td></td>
<td>Female</td>
<td>11.88</td>
<td>1.44</td>
</tr>
<tr>
<td>2</td>
<td>Male</td>
<td>11.89</td>
<td>1.62</td>
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<td></td>
<td>Female</td>
<td>12.00</td>
<td>1.57</td>
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<td>3</td>
<td>Male</td>
<td>13.32</td>
<td>1.20</td>
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<tr>
<td></td>
<td>Female</td>
<td>11.27</td>
<td>1.93</td>
</tr>
<tr>
<td>4</td>
<td>Male</td>
<td>12.53</td>
<td>2.07</td>
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<tr>
<td></td>
<td>Female</td>
<td>11.68</td>
<td>2.49</td>
</tr>
<tr>
<td>5</td>
<td>Male</td>
<td>12.20</td>
<td>2.47</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>13.31</td>
<td>1.58</td>
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</tbody>
</table>
APPENDIX D

TWO BY TWO LATIN SQUARE ANALYSIS OF VARIANCE
FOR THE PATTERNS TEST AND THE MAZE TEST
TABLE 3
TWO BY TWO LATIN SQUARE ANALYSIS OF VARIANCE
FOR THE PATTERNS TEST AND THE MAZE TEST

<table>
<thead>
<tr>
<th>SOURCE OF VARIATION</th>
<th>d.f.</th>
<th>SUMS OF SQUARES</th>
<th>MEAN SQUARE</th>
<th>F</th>
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<tr>
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<td>680.8363</td>
<td>153.96 *</td>
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<td>17.0454</td>
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<td>14.4272</td>
<td>14.4272</td>
<td>3.26</td>
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<td>Error</td>
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</tbody>
</table>

* significant at the .01 level of confidence