APPLICATION OF THE COLORED PROGRESSIVE MATRICES TEST FOR THE JAPANESE KINDERGARTEN CHILDREN

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The main purpose of the present paper is to give some information about Raven's Colored Progressive Matrices Test and to investigate its applicability for the Japanese pre-school children, since this test has never been used either in Japan or in any countries in the Orient. A series of matrices tests were devised by John C. Raven in England as early as in 1930s. It is said that his first test somewhat resembled a test used by Carl Spearman. But the present forms of the Colored Progressive Matrices Test, Sets A, Ab, and B, and the Standard Progressive Matrices Test, Sets A,B,C,D, and E are Raven's original devices.

The information of the Standard Progressive Matrices Test designed for use with persons from the age of 9 onwards to maturity will be given at some other opportunity. The present paper deals only with the outline of the 1956 revision of the Colored Progressive Matrices Test which is suitable for children between the ages of 5 and 11 years, and its statistical values obtained by other authors and from my tests on the Japanese kindergarten children.

THE TEST

Raven's Colored Progressive Matrices Test is a series of thirty six matrices or abstract designs, from each of which a part has been removed. Thirty six items are arranged into three sets, A, Ab, and B, each containing twelve matrices arranged in the order of increasing difficulty.

Each item is a matrix from which a part is missing, and six pieces of the same size and similar form as that of the missing part are arranged. Among these six pieces, only one is correct. The subject is asked to choose the missing insert from six given alternatives.

The test is available in both book form and board form, the latter requiring the subject to insert the right piece rather than choose the correct completion. The subject is asked to work all of the problems without hurrying. Furthermore, there is no time limit.

Since the instruction of the test is very simple, this test can be used with children who understand or speak any language very little and with children who are physically or mentally defective.

Raven's test is also available for cross cultural study of intelligence, because the test items are relatively common to many cultures. H.J.A. Rimoldi (8) obtained closely similar norms to Raven's test to British children on 1,680 children in Argentina, suggesting the applicability of this test to different cultures.

Each item of Raven's test is the "mother" or "source" of a system of thought. Therefore, the name "Progressive Matrices" is given. However, this is not a test of "general intelligence." Raven suggests the use of a vocabulary test in connection with the Colored Progressive Matrices Test. For this purpose the Crichton Vocabulary Scale is prepared by Raven. While the Crichton Vocabulary Scale provides an index of a person's general

cultural attainments, the Matrices Test indicates a child's present capacity for intellectual activity whatever knowledge he has acquired. By using the Matrices and Vocabulary Tests together, a person's present capacity for intellectual activity and his general cultural attainments can be measured separately.

Coefficient of correlation of the Matrices Test with both the Crichton Vocabulary Scale and with the Terman-Merrill Scale is about 0.50, and a re-test reliability of the Board and Book Forms of test is around 0.65 for children under 7 years old. Correlation of the Matrices Test with both the Crichton Vocabulary and Terman-Merrill Scales is about 0.65, and the re-test reliability of both the Board and Book Forms of the test is more than 0.80 for children under the age of 9 (7).

A factorial analysis of the Progressive Matrices Test was made by Rimoldi (9) in 1948. He reported that there was one factor common to all of the sets of the Raven's test. Rimoldi

considers it as similar to Thurston's factor I. The spatial factor "s" is also considered to be significant in performance on some of the Matrices Test. On the other hand, Raven himself considers his Matrices Test as a measure of Spearman's "g" factor.

On the whole, the Raven's Colored Progressive Matrices Test and the Standard Progressive Matrices Test seem to be very promising tools for various kinds of testing purposes.

METHOD

Subjects: The subjects were 80 kindergarten children (45 boys and 35 girls) from three kindergartens in Hyogo Prefecture composed of middle and upper middle class residents. The age range of the children was from 4 1/2 to 6 1/2 years.

Procedure: Intelligence testing was done to all subjects with 1) 1948 revision of the Suzuki Binet Test standardized by Harutaro Suzuki using 11,546 Japanese children, 2) the Goodenough Draw-a-Man Test, and 3) the Colored Progressive Matrices Test. The subjects were divided into two groups. The intelligence of one group was measured by the Suzuki Binet Test, the Draw-a-Man Test, and the Board Form of the Colored Progressive Matrices Test. The other group was assessed by the Suzuki Binet Test, the Draw-a-Man Test, and the Book Form of the Colored Progressive Matrices Test. These three tests were administered to each subject within a week usually. Some subjects could finish all three tests in a day, but any cases when the subjects looked to be tired of taking tests successively, no more testing was done.

The experimenter made the Board Form of the Matrices Test himself according to the instructions in the guide book (7), because the test was obtainable only on loan from the Crichton Royal Department of Psychological Research, 20 Castle Street, Dumfries, Scotland.

Correlations of both Board and Book Forms of the test to the Suzuki Binet Test and the Draw-a-Man Test were computed. Since the percentile norms reported by Raven were based on quite small British samples* the author figured out the correlations from the raw scores of the tests.

*Percentile norms for the Board Form of the test were figured out from the scores obtained by 291 Dumfries School children over 5 and under 10 years old, and the norms for the Book Form of the test were calculated from the scores obtained by 608 Dumfries School children between the ages of 5 and 11 1/2 years.

RESULTS

The item difficulty of Sets A, Ab, and B is presented in Figure 1, 2, and 3. The vertical line indicates the percentage of passes on each of the 36 items, and the horizontal line shows each item number of Sets A, Ab, and B. It is evident from the figure that the order of the

Fig. 1

Fig. 2

Fig. 3

problems which was arranged by the author of the test is generally appropriate. Item 10 of Set Ab is exceptional. The percentage of pass on Item 10 is remarkably higher than those of the antecedent items in both Board and Book Forms of the test. Although the percentage of pass on Item 1 of Set A is relatively low, it does not mean that the item is more difficult than the following items. Since no item is prepared for giving instructions for the test, Item 1 is used for the purpose of practising the test. More than 60 percent of the subjects passed on Item 1 after the simple instruction was given, but the rest of the subjects failed in the first trial. Therefore, a fuller explanation was given to the subject who failed in the first trial so that he might thoroughly understand the idea of the test.

The percentage of pass on the Board Form is generally higher than one on the Book Form. Raven has obtained approximately similar results on the British sample(7). It is quite natural, because in the Board Form of the test the subject can see if his answer is correct by

putting a piece of form on the board. Therefore, Raven made the norms for the Board and the Book Form of the test separately.

Table 1

Coefficient of Correlation of the Matrices Test with the Suzuki Binet Test and with the Draw-a-Man Test for Children between 4 1/2 and 6 1/2 Years of Age.

Colored Progressive Matrices Test	Suzuki Binet Test	Draw-a-Man Test
Board Form	+0.50*	+0.38**
Book Form	+0.59*	+0.57*

* Significant at .01 level

** Significant at .05 level

The coefficient of correlation of the Board and Book Forms of the Matrices Test with Suzuki Binet Test is .50 and .59, both of which are significant at .01 level. The correlation of the Board Form of the Matrices Test with the Draw-a-Man Test is significant at .05 level, and the correlation of the Book Form of the Matrices Test with the Draw-a-Man Test is significant at .01 level. The correlation between the Suzuki Binet Test and the Draw-a-Man Test is .23, significant at .05 level. The results is presented in Table 1.

It is noted from Table 2 that there is no significant sex difference between the mean scores of boys and of girls.

As the number of subjects is quite small, and the sample is limited to the kindergarten

Table 2
Sex Differences in the Matrices Test

Sex	Board Form			Book Form		
	Number	Mean Score	Sigma	Number	Mean Score	Sigma
Boys	29	20.1	6.6	16	13.9	3.2
Girls	21	19.7	5.8	14	15.4	3.5
		$t=.23$			$t=1.26$	

children, further research must be made on the problems mentioned above.

DISCUSSION

It is one of the most important characteristics of the Matrices Test that the subject is highly motivated for taking the test. As far as I was aware no subject rejected taking the Matrices Test. Even the subjects who objected to taking the Draw-a-Man Test and the Binet Test were motivated to the Matrices Test. For this reason the Matrices Test is the most useful tool to measure the intelligence of the children to whom it is impossible to administer other psychological tests.

The Matrices Test has another merit in its applicability to the subjects who have different cultural backgrounds. As the instruction of the test is very simple, this is also available for the children suffering from physical disabilities, and for the children who are intellectually sub-normal or mentally deteriorated. If the Matrices Tests are carved, they will be available even to the blind.

Raven's norms both for the Board Form and the Book Form must be scrutinized, for Raven figured out the total score from the expected score on Set A, Ab, and B. I found trouble, however, when I computed the total score according to the expected score on each set made by Raven. Some subjects obtained pretty high scores on Set A or Ab, but lower or far lower scores than the expected score on Set B. It does not seem to be fair to figure out the total score from the set of the lowest score. For example, one subject obtained 10 scores on Set A, 7 on Set Ab, and 2 on Set B. Another subject obtained 8 on Set A, 4 on Set Ab, and 1 on Set B. If the total score is computed from the expected score on each set, the total score of these two subjects will be 10, and the percentile points estimated from the total score will be under 25. Therefore, it is advisable to compute the total score from the raw scores on each set rather than to do it from the expected score on each set.

Since there are six possible answers to each item, only one of which is correct, the probability of a right answer is $1/6$. Therefore, the subject knows nothing whatever about the test, his final score is $1/6 \times 36$ or 6. It is understandable from the probability that Raven's lowest expected score on each set is 2. From the formula; $\sigma = \sqrt{npq}$, a total score of 10 is significant at 5% level, and a total score of 11 is significant at 1% level. Therefore, the subject who obtained more than 11 scores in total is not merely guessing.

One sample item ought to be given in order to give full instructions before starting Item 1 of Set A. In this way the percentage of passing on Item 1 of Set A is improved.

SUMMARY AND CONCLUSIONS

The general aim of this study is to investigate the applicability of the Colored Progress-

sive Matrices Test for the Japanese kindergarten children.

The sample consisted of 45 boys and 35 girls between the ages of 4 1/2 and 6 1/2 years. They were selected from three kindergartens in Hyogo Prefecture, Japan.

The Colored Progressive Matrices Test, the Suzuki Binet Test, and the Draw-a-Man Test were given to all subjects, and the coefficients of correlation were computed. The Board Form of the Matrices Test has shown a correlation of 0.50 with the Suzuki Binet Test, significant at .01 level, and a correlation of 0.38 with Draw-a-Man Test, significant at .05 level. The Book Form of the Matrices Test has been found to correlate 0.59 with the Suzuki Binet Test, significant at .01 level, and to correlate 0.57 with the Draw-a-Man Test, significant at .01 level. Correlation between the Suzuki Binet Test and the Draw-a-Man Test is 0.23, significant at .05 level.

The items of three sets are generally arranged in the order of difficulty except Item 10 of Set Ab. It is advisable to move Item 10 two or three items ahead, because it seems to be easier than some of the previous ones.

Although the mean score of boys is 0.4 higher than that of girls in the Board Form of the test, and the mean score of girls is 1.5 higher than that of boys in the Book Form of the test, the sex differences in the Matrices Test are nonsignificant. ($t = 0.23$, and 1.26)

It was found by the various studies above mentioned that Raven's Colored Progressive Matrices Test might be a most promising tool to measure intelligence not only of the normal children who have different cultural backgrounds, but also of the children who are mentally and physically handicapped. My present study has shown that the Matrices Test is also a very useful intelligence test for the Japanese preschool children.

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