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PREDICTION OF LEARNING ABILITY ACROSS CULTURES

by

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The Requirements for the Degree of
DOCTOR OF PHILOSOPHY

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INTRODUCTION

The Western educational system, although in appearance diversified from school to school and class to class, has as its underlying standard a culturally impregnated set of values, motives and goals. It functions as though all children have had a background of experiences congruent with the middle class standard. Differences within cultures are present but schools generally focus on the quality, not the kind of educational program. A major goal of American education has traditionally been to socialize the child so that he will be able to develop into a useful citizen in this culture.

There are many students who do not adjust to this form of socialization. Notable among these are the students who do not progress at the rate of the standard set by the system. This standard of progress has been developed from normative studies which assume a capacity of intellectual ability and a background of experiences generally available in the middle class culture of America. In the case of limited intellectual ability the student is diagnosed "mentally retarded" and placed in a special class where, hopefully, the curriculum is developed to meet his needs and the pace is adjusted to his limitations. Generally the school attempts to adapt its program to develop the skills of the individual to the extent that his capacity allows. The culturally handicapped individual

may not be limited by intellectual potential but rather, he fails to progress due to a limitation of background experiences common in the major culture.

The distinction between these two groups of handicapped individuals is important. The handicaps of culture can be prevented by social change or reduced by a program of cultural enrichment.

The problem of differential diagnosis between mental retardation and a culturally limited background is still largely unsolved. This problem has a history in the environment-heredity dichotomy which ascribed differences to heredity during the 1920-30's but more recently has placed emphasis on environmental patterns. Early testing of culture groups found differences in intellectual functioning in favor of the dominant culture group. These differences were attributed to basic inherited inferiority. Later studies suggested the experiential-cultural facet of the retardation. It was hypothesized that all races were equally endowed with intelligence and studies indicated that the tested differences in intelligence decreased greatly as the environmental conditions became more similar. This controversy has by no means been settled at this date. (See Jensen, 1969).

The child whose cultural background is different from that of the main stream of America faces numerous and increasing problems in the public school. The decline in academic progress of these students seems to parallel the tested

intellectual decline. Relatively small differences in intellectual ability are found in kindergarten and first grade, but these differences become larger with each additional year. The background experiences have not prepared the child to profit from the educational experience. He has not learned habits of attention, sources of appropriate information, or expectations of reward for academic skills. He often has a limited language or only inappropriately culturally oriented language experiences. With these handicaps he finds lack of success in the school frustrating and seeks satisfaction in other places. Educational guidance is limited by a lack of appropriate aptitude tests for these students.

An intelligence test can be thought of as a description of a person's present knowledge and intellectual functioning such as problem solving, and dealing with abstractions; this combination is often used to predict academic success, and may be called a kind of aptitude test.

Roberts (1969) reviewed and evaluated a number of empirical studies on the relation of abilities and aptitudes to different phases of learning. With regard to abilities he concluded that (1) many ability factors have been identified, and (2) no single ability factor can account for all the variance on all learning factors. The correlations between ability and/or aptitude (Roberts did not differentiate between these terms) and performance were found to be complex and it varied with different stages in the learning process. In verbal

learning he noted that intelligence as a predictor did not change with practice on a learning task. He reported work which found that the relationship between aptitude and performance was initially significant and positive but decreased to nonsignificance with practice on the performance task.

In the construction of a model of school learning Carroll (1963) considered aptitude as a major variable. He defined aptitude as "the amount of time required by the learner to attain mastery of a learning task." Students have been found to be normally distributed with respect to general aptitude (Bloom, 1964) and aptitude has been correlated relatively highly with achievement (Carroll, 1963). This correlation (about = .70) was obtained when all students were given exactly the same instruction in terms of both quality and time. However, if students are normally distributed according to aptitude but the quality of instruction and the time allowed for mastery is made appropriate to the needs of the individual students, the majority of students may be expected to achieve mastery. In the latter case the correlation between aptitude and achievement should approach zero (Bloom, 1964).

These studies indicated that there was a correlation between general aptitude and achievement, and practice and achievement. The study reported here proposed to incorporate these two sources of variance, aptitude, and practice, to predict achievement.

An intelligence test, as related above, evaluates

knowledge and information which the individual has acquired; it is therefore a cultural concept reflecting the effect of the environment in which the learning took place. Insofar as it measures aptitude it can be used to predict future learning. However aptitude is also a cultural concept because it refers to culturally specific learning which is appropriate for the culturally determined environment.

When a person from a given culture is evaluated by an instrument of a different culture the person is handicapped by his culturally determined performance.

A large number of research publications have consistently shown that deprived cultural groups score low on intelligence tests (Kennedy, Van de Riet, and White, 1963; Neel, 1964). To evaluate these tests as unfair is meaningless for they do reflect the actual conditions: a culturally deprived child's performance in school will be poor (McNemar, 1964). Anastasi (1968) suggested that the same cultural differentials that impair an individual's test performance are likely to handicap him in school work, job performance, or any other activity we are trying to predict.

Anastasi (1958) examined the impact of culture on performance:

> The experiences of people living in different cultures may ... lead to basically different perceptual responses, lend a different meaning to their actions, stimulate the development of totally different interests, and furnish diverse ideals and standards of behavior. (p. 558)

She further examined the problems of evaluating performance in cross-cultural testing. She concluded that there were five culturally defined areas: (1) The analysis of individual or group endeavors, (2) the speed factor, (3) the accuracy of performance, (4) the motivation and interest and (5) the social expectancy.

Eells et al. (1951) in his review of the basic issues in the relation of intelligence tests to cultural background developed a hierarchical model of acculturation. In America he sees a basic or common set of traits and behaviors, at another level a set of behaviors related to socioeconomic levels and finally a set of behaviors related to ethnic or nationality groups. He suggested that tests should try to control or equalize the cultural factors in test problems. Most intelligence tests are not of general intellectual activity, because the problems are drawn from the experience of the middle class; there should be some problems that draw from the experiences of the lower class, where the lower class would be evaluated superior. In examining the work habits and their effect on test-taking behavior he suggested that there was no reason to expect that this would generalize to items across cultures.

The areas most often used to account for cultural differences in test performance are verbal loading, speed requirements, test content, test taking experience, and examiner rapport. The verbal saturation of test items has been examined in a number of students. Goodenough (1926), Anastasi and

De Angelo (1952), Kennedy and Linder (1964), Coppinger and Ammons (1952) and Hammer (1954) all found Negro-white differences on verbal ability tests.

The question of the speed factor may well exist between some cultures; however, Rhodes (1937), Lambeth and Lanier (1933) and Moore (1941) reported no differences in simple tasks of psychomotor ability between Negro-white groups.

Maller and Zubin (1932), Benton (1936) and Klugmen (1944) examined the effect of motivation and found no significant differences. Boyd (1952) measured the "Level of Aspiration" in a northern non-segregated school and found Negroes to have a higher level of aspiration than white students in the same intellectual groupings.

The use of an examiner from a different culture has been examined by Vernon (1969), who found evidence that there was a slight tendency for children to score higher when tested by an examiner of their own race.

When tests were evaluated to determine specific areas of differences, Franklin's (1945) data indicated that a "perceptual ability factor' discriminated between Negro and whites. De Stephens (1953) using the Wechsler-Bellevue, found Negro boys deficient in Block Design, Digit Symbol, Arithmetic, and Picture Completion sub-tests. Clarke (1941), using the Stanford Binet and matching subjects on overall IQ, found Negroes to be low on Arithmetic Reasoning, Repeating 5 Digits reversed and Picture Absurdities.

Higgins and Siners (1958), used the Ravens Progressive Matrices, a test of general intellectual capacity. This test is composed of a number of designs or figures of which a part is missing; the individual is required to select the correct answer which completes the pattern presented. They found differences between white and Negro children who were matched for IQ on the Stanford Binet and socio-economic level. The Ravens Progressive Matrices loads high in the area of Spearman's 'g' and the perceptual reasoning factors. (MacArthur, 1968).

The selection of a test to measure learning ability across cultures requires consideration of the 'g' loading, the stimulus bias and the response bias.

The 'g' factor hypothesis was challenged by Thurstone and later by Guilford. Thurstone found the general factor as a second-order factor by analysis of the primary factors. Guilford suggested that the 'g' factor was an artifact of the analysis and developed a theory of intellect with three major parameters: operation, product, and content (Guilford, 1967).

The Spearman 'g' loading or general intellectual ability is the single best predictor of learning ability by definition (Hagen, 1963). A number of factor studies (Romilde, 1948; MacArthur, 1961; and Vernon, 1965) have all found the Raven's Progressive Matrices to be high in 'g' loading. These correlations range between .51 and .82 which is equal to or better than other tests examined. The Ravens Progressive Matrices

seems to qualify for the requirement of a high 'g' loading.

That stimulus material should be free from cultural bias is another important requirement of a culture-free test, however, the Raven's Progressive Matrices appears to only partially meet this need. Hopi Indians, for example, should score higher on the Ravens' Progressive Matrices because of their early experience with designs (Dennis, 1965). The Negro sub-culture scores low, as was found by Higgins and Siners (1958). In view of this bias a correction should be made.

The Stimulus bias can be seen in perceptual material where training has different effects on cultural groups. Two studies, Boger (1952) and Eagleson (1937) indicated that perceptual discrimination can be affected by training with feedback. Both studies indicated that Negroes, who were initially deficient in this area, improved more than white students and Boger further found the improvement was maintained. Thus the Scale should offer some method of training with the test material if perceptual designs such as the Raven's Progressive Matrix is to be used. Furthermore, some method of correcting for cultural bias of the stimulus material should be included. It seems logical that if cultural bias exists and as Boger and Eagleson found those with the greatest cultural handicap improved most from training, that the differentiation score may offer such a correction.

Response methods should be corrected for, or free from cultural bias. It has been pointed out by Anastasi (1964) and

others that the familiarity with paper and pencil tests, test answer sheets, etc. has a definite cultural bias.

In summary, the research literature indicates in spite of existing weakness, intelligence tests are the best available predictors of academic success (Hagen, 1963). All tests, however are culturally biased and discriminate in favor of the middle-class student (Eells, et al., 1951; Anastasi, 1964). In the case of the various culture-free scales Anastasi found a lower correlation with teacher judgments and achievement tests than conventional intelligence tests. Haggard (1954), Miller and Swanson, (1960) have stated the problem as: removing the middle-class bias but retaining the essential quality of the scales. Dyer (1960) concluded that it would be better to improve the environment of the culturally deprived than change the tests because of the lowered reliability and validity.

A number of investigators (Anastasi, 1964; Glick, 1966; Irvine, 1968) have suggested that training has a differential effect across cultural groups: Those who are most deprived achieve most from instruction. It would appear therefore that the factor could be utilized in improving cross-cultural testing instruments.

METHOD OF PROCEDURE

Problem

The problem investigated in this study was: Is it possible to increase the predictive ability of an intelligence test across cultures by furnishing information regarding the correctness of the response to the individual at the time of testing?

The research indicates that one of the factors which affects individual scores is the amount of practice with items similar to those contained in the test. Individuals in cultures which offer limited practice in test taking should show the greatest increases. These individuals should show low-initial scores and profit most from the practice.

The hypotheses tested in this study were as follows:

1. Initial testing will show significant differences between cultures.

2. These differences will be significantly reduced on the second testing following the initial practice period.

3. The second testing will more accurately predict learning ability as defined by achievement ratings.

Development of the Scales

The two forms of the Raven Progressive Matrices (1960, 1965) consist of 108 individual items. The two scales are

not, however, equivalent; the 1960 scale was designed to cover the widest possible range of mental ability while the 1965 set was devised to evaluate persons of above average intellectual capacity. The investigator decided to pool the 108 items and develop from them two 40-item equivalent scales.

Due to the high similarity of some of the items in the 1960 matrices to items in the 1965 matrices, the items were judged for similarity in appearance by 67 students in two sections of an educational psychology class. Those items which were judged similar to another item by more than 50 percent of the students were identified. One of each pair of items rated in this manner as similar in appearance was randomly discarded from the item pool. Twenty-two items were discarded (see Appendix A), leaving a pool of 86 items.

The remaining pool of 86 items was presented to different student judges in an educational psychology course. The students were asked to select pairs of items from this pool which were similar in difficulty. Initially the students selected a single pair from the 86 items judged to be similar in difficulty. Next, the students were asked to select from the remaining 84 items another pair judged to be similar in difficulty. This procedure of deleting judged pairs of similar items was continued until the student could no longer identify items of similar difficulty. These judgments ranged from 72 to 92 percent agreement. (See Appendix B).

The pairs of items judged as equal in difficulty were separated into two groups randomly, by use of a random numbers table, and thus the two experimental forms of the Raven Matrice were differentiated. (See Appendix C).

The Matrices items, as originally developed by Raven, utilized 6 or 8 possible answers for each item. The Pressey Answer Board which is a simple teaching machine used to record the testees' responses. It has only four possible answers and therefore it was necessary to reduce the number of possible answers.

The foils of the Matrices items included in the experimental scales were evaluated by 34 students of an educational psychology class for "goodness of fit". The students were directed to select the four best possible answers to each matrix item. The judgments ranged from 68 to 92 percent agreement. (See Appendix D).

Through this method two forms rated as equivalent were obtained with 40 items each. (See Appendix E). These matrices were reproduced in slide form to make them available for group presentation by projection.

Evaluation of equivalent forms

The equivalent forms were presented to two 6th grade classes of the Boone, Iowa Schools. These tests were presented in group form by projecting the matrices on a screen and using a standard IBM answer sheet to record the student responses. An evaluation of the reliability of the tests was accomplished

by administering both forms to both classes. The schedule of presentation is shown in Table 1.

Table 1. Presentation of forms

Classroom Source	Tuesday	Thursday
Page Elementary School	Form A	Form B
Franklin Elementary School	Form B	Form A

The subjects represent two classroom groups of the Boone community. Page School is representive of the general middle class in the Boone area, while the Franklin group is generally considered to be composed of students of the lower class and lower middle class.

These classroom groups are separated according to ability grouping principles of the school. The Page classroom group is classified as the middle ability level where the exceptional students are separated into either the upper ability level or into the lower ability level in special education. The Franklin classroom group was classified as the upper ability level within the Franklin school. Considerable overlap, however, exists in these classifications of ability level between the two schools. In the Page school the IQ range is from 87 to 120 while the Franklin school range is from 95 to 124. When combined they represent a general picture of the students attending the regular public school. Their counterparts in special education were not evaluated. Therefore a correction for restriction of

range was calculated for reliability estimates.

Item difficulty level was calculated and a correlation ($\underline{r}$ = .72) between paired items was computed (See Appendix F).

Table 2. Standardization data

Group	Form	Mean	Ave. Item Diff.	S.D.	KR_{20}	Error of Meas.
A:B	A	24.31	.39	4.30	.68	2.45
	B	25.66	.36	5.12	.76	2.50
B:A	A	27.62	.31	3.21	.51	2.25
	B	26.50	.34	6.00	.83	2.49
Combined	A	25.73	.36	4.18	.67	2.40
	B	26.02	.35	5.48	.79	2.52

As indicated in Table 2, the average item difficulty for Form A was .36 and the mean number of correct responses was 25.73. Form B had an average item difficulty of .35 with a mean number of correct responses of 26.02. This was accepted as evidence for equivalence of forms.

When the reliability estimate between the two forms was corrected for restriction of range according to the Guilford formula (1) (Nunnally, 1967)

$$(1) \qquad Rxx = \frac{r_{12} \left(\frac{\bar{S}_1}{S_1}\right)}{1 - r^2_{12} - r_{12}} \left(\frac{S^2_{12}}{s_{12}}\right)$$

the reliability estimate is increased to .85, which is approximately the median value of the reliabilities reported by Raven (1960). It should be noted, however, that omission of the three items which do not discriminate due to representation errors should increase this reliability.

Answer Board

The Answer Board was a form of a teaching machine which allowed the student to obtain information regarding the correctness of his response. It was constructed in such a way that the key could be changed through the use of a special metal sheet inserted into the Answer Board.(See Appendix G). The operation of the Board was accomplished by use of a pencil. The answer to the problem was selected as either A, B, C, or D, in a multiple-choice format. The student was to insert his pencil in the hole of his choice. If the pencil extended deep into the board, the answer agreed with the key and the student proceeded on to the next item. If the pencil was stopped by the key and did not extend deep into the hole, the answer the student chose was not correct and he tried another answer for that item. He continued in this manner until he obtained the correct answer.

The Answer Board offered several advantages to this research: it furnished automatic feedback to the student about the correctness of his response; this feedback was furnished without the use of language, which appears to be critical in

cross-cultural evaluations; and it supplied each student with the same amount of information regarding the test items.

The Answer Board was easily scored for both the number of correct items, those items in which the answer sheet had only one punch, and the total number of trials necessary to successfully solve all problems was the number of errors plus the number of problems; therefore, the answer sheet furnished both the number of correct responses on the first trial and the number of errors.

Subjects

The culture groups of this study were selected to represent diverse life patterns. Culture is defined for this study as the pattern of a society including the social institutions, knowledge, beliefs, morals, customs and habits acquired by man as a member of the society. Cultures were further divided into social classes. Social class was defined as a division of a culture in which the people have certain common characteristics which qualify them to participate in social relations with others of the group (English and English, 1958). In the present study determination of social class was made by school authorities: in the Des Moines, Iowa, schools by the Director of the Department of Educational Research, and in the Mexican schools by the Director of the Institute Interamericano de Estudies. The Eskimo sample was comprised of the entire population of Eskimo children in the Frobisher Bay area. Because the

Eskimo culture was basically a hunting group, few class differences, if any, exist.

Canadian Eskimos

The Canadian Eskimo sample was obtained at a boarding school (hostel) at Post and Apex, in the Frobisher Bay area of Northern Canada. The families of these children belong to a hunting society where the basic social organization is the nuclear family or a small band of interrelated families. The Eskimo culture is highly permissive towards, and fond of, young children. The boys adopt the general masculine role: hunting, fishing, trapping, etc.

The tradition of generosity and sharing within the band is still prominent. The basic needs of the Arctic Eskimo are satisfied through an interdependence within the group. The family seems less personally involved with the individual child than in Western cultures. The family, however, is almost always affectionate and supportive to the child. Children are freely adopted and even in some cases interchanged. The move to boarding schools at the age of six or seven does not seem to produce much emotional disturbance. This may in part be due to the relative freedom from the close, possessive ties common in the middle class Western society.

Mexican sample

The Mexican sample was obtained from Chihuahua, an interior city of 250,000 people. Chihuahua is an industrial center with

mines, plastic production and textile factories. The city is isolated by American standards; it is served by one airline, Areonavis, a Greyhound bus line, and a tourist railroad. The general financial level of the population does not support extensive trading in other cities. Chihuahua is located approximately 250 miles south of the U.S. Border and about the same distance from the major urban areas of Mexico in the south.

The city has three school systems, the private schools often operated by the catholic church and far too expensive for any but the upper class. The public school which is totally government supported and which offers free education and generally is understaffed, poorly equipped and without the services of psychologists, social workers or special teachers. The Promociones Educativas is a system jointly supported by private funds and government. There is a tuition charge of $25.00 (U.S. $2.00) per year. This system services the broad spectrum of the middle class and uses the tuition and funds for building new schools and equipment.

The students typically come from large families of 6-10 children. The home is traditionally paternalistic. The schools operate in two shifts, morning and afternoon. The curriculum is standardized for the country and a general book is issued each child which contains the course material for the year.

The subjects for this study were obtained from the Promociones Educativas number 1. These students were classified as middle class for the Mexican culture by the school

authorities. The students live within the general area of the school, a district of middle class homes; and their parents are employed by the local industry as skilled workers.

Negro sample

The sample of American Negroes was obtained from two sources, Des Moines, Iowa and Odessa, Texas. The group from central Iowa was from a school which had served a Negro community within a city of 220,000. The integration of the school system in the city has limited the number of students of any given age group below the number needed for the study therefore, a group of students in southwest Texas was added to increase the number of subjects to 33.

In both cities the population was urban and the cities generally were industrial -- equipment manufacturing, plastic production. The population of both is considered stable. The school system in both cases is controlled by board of education for the city, and classes generally range from 25 to 35 students. The general financial level of the families of the sample was bordering on the poverty criterion of $3000.00. These schools were located within the lower class section of the city as defined by the school authorities.

Middle class sample

The middle class sample was obtained from Des Moines, Iowa, a city of approximately 220,000. This city is the same as described in the Negro sample. The group was drawn from a

school which serves the middle class section of the city. This school district was classified as middle class by the Department of Educational Research. They stated that the homes of these pupils were evaluated at between 15,000 and 25,000 dollars. The school personnel indicated that the parents have completed between 10 and 16 years of education, the average educational level is about one year of college.

All subjects were within the age range from 11 - 7 to 12 - 6 at the time of testing.

Procedure

The administration of the tests was accomplished in every case through the classroom teacher. The teacher was given a sheet of instructions (see Appendix G) and in the cases of the Eskimo and Mexican groups, the instructions were translated to their native language by an interpreter who was instructed in the general experimental procedure.

The first test was an arithmetic examination (Jastak, 1946) which was given to familiarize the student in the use of the answer board. The students during this test were encouraged to experiment and determine correct from incorrect answers. Close attention to their use was given by the teacher.

The second test, Raven Matrices Form A, was given on the

following day. The answer boards were distributed and the student wrote his name on the place designed for that purpose. The students were informed that they would be shown: 40 slides of designs, that in each major design a part was missing and that they should select from the four possible answers presented the one that fit and would complete the major design. They were to indicate this choice on the answer board by punching the letter which identified the part they selected. If this was the correct answer the pencil would extend into the answer board, if not, it would only penetrate the paper and they should re-examine the problem and make another selection. The slides were presented at a time sequence of approximately one per minute, however in every case, the projectionist would determine that all students had completed the problem before going on to the next slide.

The third test, Raven Matrices, Form B, was administered after a one day rest period following Form A. Form B was administered in the same way as Form A. The instructions were identical.

Achievement ratings were obtained from the schools. They were asked to supply the achievement rating obtained on the last standardized achievement test administered for the entire group. In Canada it was a National Achievement Test, in the United States the Iowa Test of Basic Skills, and in Mexico a National Achievement Battery. All of these tests had been administered within the preceding three months.

Scoring procedure

The answer boards can be scored in two ways: (1) by counting the number of correct answers obtained with a single punch and (2) by counting the total number of punches or trials necessary to complete the entire sequence. This total number is equal to the number of mistakes plus 40, the number of problems. Because the number of problems is a constant, the total number is equal to the number of mistakes.

For each student, four scores were recorded: number of correct responses, total number of responses to correct completion for Form A and Form B.

RESULTS

A summary of the data obtained is presented in Table 4. This table shows the means and standard deviations for each of the tests and the achievement ratings for each of the culture groups (see Appendix H). An analysis of these data and the correlation matrices presented in Tables 4, 5, 6, 7, and 8 indicate the "number of errors" measure for each test was highly correlated with the "number correct" measure. The correlation between the "number correct" and the "number of errors" were -.9379 and -.9532 respectively.

A summary of the analysis of variance for the number correct on the two tests is presented in Table 3.

Table 3. Summary of the analysis of variance for the number correct

Source	D.F.	Mean Square	F
Cultures	3	1492.60	25.83*
Subjects/Cultures	117	57.78	
Forms A and B	1	52.76	3.57
Cultures x Forms A and B	3	6.29	.44
Forms A and B x Subjects/Cultures	117	14.76	
TOTAL	241		

*Significant beyond the .01 level.

Table 4. Means and standard deviations of pretest and posttest

Test	Middle Class		Mexican		Eskimos		Negro		Total	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
Form A										
Correct	31.72	4.46	21.60	7.40	21.12	7.05	19.21	6.03	23.52	8.06
Errors	53.66	10.24	75.03	21.46	77.88	13.17	79.27	12.89	71.15	18.43
Form B										
Correct	30.81	4.27	23.23	5.72	21.46	6.73	22.12	5.76	24.55	6.82
Errors	55.19	8.80	69.97	12.71	73.00	12.65	74.76	13.73	68.02	14.50
Achievement Rating	7.04	.99	6.93	.85	3.42	.65	5.14	.99	5.72	1.62

The F ratio for the differences between cultures was significant beyond the .01 level. A Duncan's Multiple Range Test (Edwards, 1965) for the differences between means indicated that the middle class differed significantly ($p < .01$) from the means of the other culture groups. The other culture groups, Eskimo, Negro and Mexican did not differ significantly from each other.

A summary for the analysis of variance for the number of errors on the two tests is presented in Table 5.

Table 5. Summary of analysis of variance for error scores

Source	D.F.	Mean Square	F
Cultures	3	10280.36	8.42*
Subjects/Cultures	117	1220.84	
Forms A and B	1	3243.79	2.45
Cultures x Forms A and B	3	171.36	
Forms A and B x Subjects/Cultures	117	1325.66	
TOTAL	241		

*Significant beyond the .01 level.

This analysis also indicated that the only significant factor was the difference due to culture. The Duncan's Multiple Range Test indicated a significant difference between the middle class and the other cultural groups.

These analyses offer support for our first hypothesis:

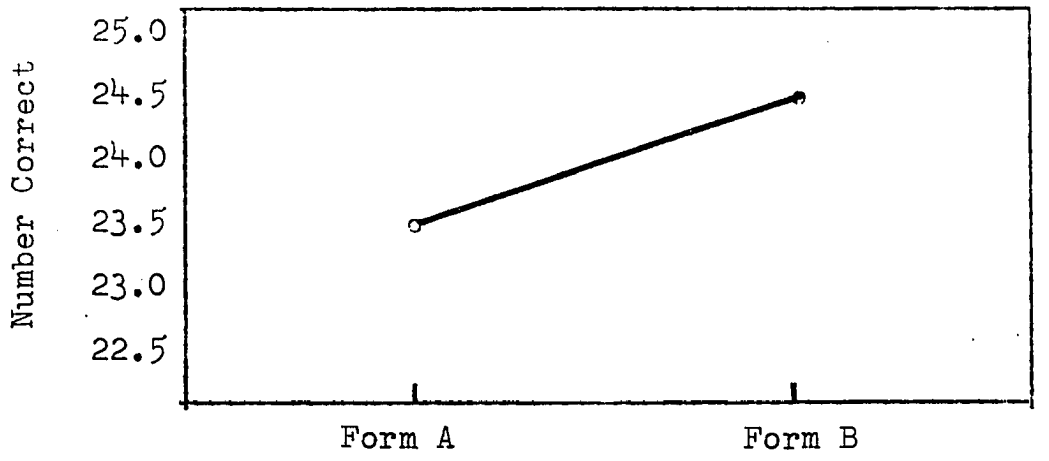

Figure 1. Mean score for all subjects on Form A and Form B

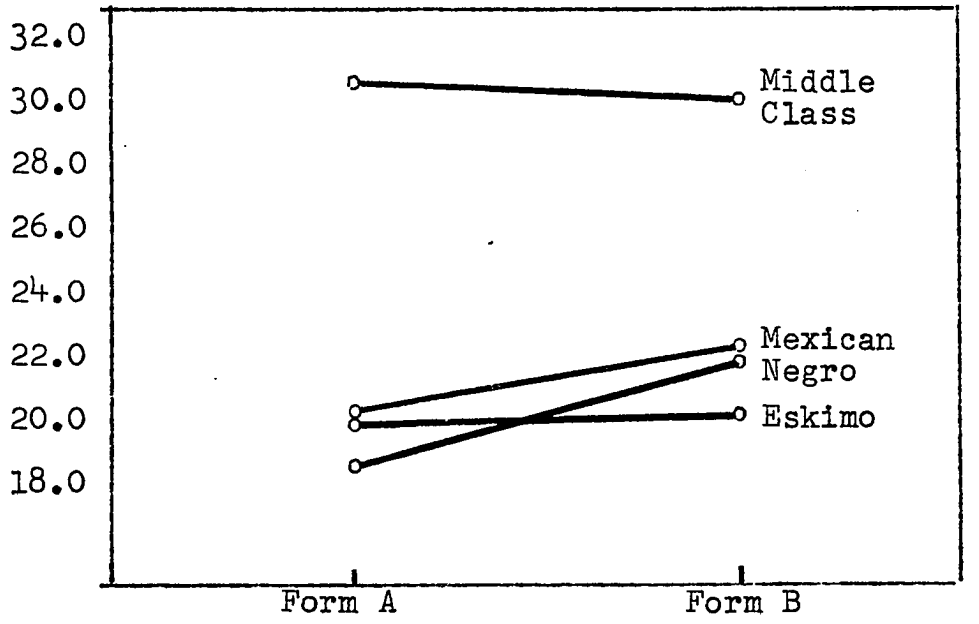

Figure 2. Mean score for cultural groups at Form A and Form B

That initial testing will show significant differences between cultures.

The differences between Form A and Form B conditions as examined by the analysis of variance tests shown in Table 3 and Table 5 did not indicate a significant difference. This result is presented graphically in Figure 1.

The interaction between cultures and Form A and B tests was not significant at the .01 level. This interaction was the test of the second hypothesis: That the cultural difference will be significantly reduced on the second testing following the initial practice period. The interaction is graphically presented in Figure 2.

The correlation matrix between the "number of correct responses", the "number of errors" on both tests and the achievement ratings is presented in Table 6.

Table 6. Correlation matrix for combined cultural sample

	Form A		Form B		
	Number Correct	Number Errors	Number Correct	Number Errors	Achievement Rating
Form A					
Number Correct	1.00	-.9379	.7228	-.7528	.4612
Number Errors		1.00	-.6340	.6879	-.4428
Form B					
Number Correct			1.00	-.9532	.4907
Number Errors				1.00	-.4572

The correlation between the number correct on Form A and the achievement rating was .4612 as compared to the correlation of .4907 between the Form B and the achievement rating. The difference between these correlation coefficients were analyzed by use of Hotelling's formula (2) for testing the differences between correlation coefficients when both correlations utilize the same subjects.

$$(2) \qquad T_{d_r} = (r_{12} - r_{13}) \sqrt{\frac{(N-3)\ (1 + r_{23})}{2(1-r_{23}^2-r_{12}^2-r_{13}^2+ 2r_{23}r_{12}\ r_{13})}}$$

The difference between the correlations was found to be not significant beyond the .05 level.

Tables 7, 8, 9, and 10 present the correlation matrices for each of the cultures individually. Tests of the differences between the correlation coefficients for scores and achievement ratings indicated that they were not significant beyond the .05 level. These data did not support the third hypothesis, that the second testing would more accurately predict learning ability as defined by achievement ratings.

Table 7. Correlation matrix for middle class America

	Form A		Form B		
	Number Correct	Number Errors	Number Correct	Number Errors	Achievement Rating
Form A Number Correct	1.00	-.9599	.4848	-.5958	.3022
Number Errors		1.00	-.5498	.6500	-.2929
Form B Number Correct			1.00	-.9533	.4208
Number Errors				1.00	-.4204

Table 8. Correlation matrix for Mexican sample

	Form A		Form B		
	Number Correct	Number Errors	Number Correct	Number Errors	Achievement Rating
Form A Number Correct	1.00	-.9465	.3393	-.4617	.3809
Number Errors		1.00	-.1826	.3412	-.2509
Form B Number Correct			1.00	-.9113	.2831
Number Errors				1.00	-.2214

Table 9. Correlation matrix for Eskimo sample

	Form A		Form B		
	Number Correct	Number Errors	Number Correct	Number Errors	Achievement Rating
Form A Number Correct	1.00	-.8385	.8438	-.8303	.4797
Number Errors		1.00	-.7195	.7315	-.4449
Form B Number Correct			1.00	-.9489	.5961
Number Errors				1.00	-.4235

Table 10. Correlation matrix for Negro sample

	Form A		Form B		
	Number Correct	Number Errors	Number Correct	Number Errors	Achievement Rating
Form A Number Correct	1.00	-.9333	.6410	-.6711	.4141
Number Errors		1.00	-.6601	.7084	-.4093
Form B Number Correct			1.00	-.9560	.3550
Number Errors				1.00	-.3815

DISCUSSION

The problem of understanding the differences between sub-cultures within a nation or widely separated nations and their major cultures leads to the investigation of either what a group can do or why the group does it. In this study the former has been explored in the area of intelligence.

Intelligence, thought of as a potential, refers to generalized thinking capacity which can be applied to any kind of new learning. Achievement, in contrast, refers to the extent to which the student has mastered a selected set of skills taught in the school. Achievement is generally thought to be more related to environment, as indicated by studies of identical twins brought up apart who tend to differ more in achievement than intelligence. The Raven Progressive Matrices have been shown to load high on "g", which is accepted as a generality of reasoning capacities, many of which may have been learned outside the school. Therefore, a test of intelligence and one which loads high on "g" should be useful in predicting educability in new subjects.

The first step in this study was to develop a scale which would reduce as much as possible the known cultural biases. These biases have led to the evaluation of divergent cultural groups on a scale developed from the Western middle-class culture and standardized within this group. Selection of the Raven Progressive Matrices was an attempt to reduce the content bias.

The test utilizes as content abstract patterns which appear to be relatively free of culturally defined concepts. The Raven scales were divided into two equivalent forms of 40 items each. The standardization of these forms were evaluated on a middle-class population and may have led to some biasing of the scales. With the use of these scales the basic questions of this study were undertaken. Will a test constructed of items found to load heavily on "g" differentiate cultures, and if it does, can the cultural differences be reduced by a short-term practice session?

This practice period was developed to give the unsophisticated student an experience of test-taking and to allow him an opportunity to gain some skill in the discriminations demanded in the tests. If the culture group had few of these experiences, then practice should increase the abilility of the test to measure intelligence by reducing error due to cultural biases in test-taking practice and to unfamiliar test content.

The use of intellectual measures has been found to relate to a number of different social, economic and academic classifications. The most common use of intelligence testing is within the schools to predict academic achievement. In fact, most measures of intellectual ability have been validated against measures of academic achievement. In this study we have utilized academic achievement as the criterion for efficiency of the two forms of the Revised Raven Matrices.

The results of this study indicated that there were major differences in the tested intellectual ability of the different cultural groups sampled. These differences were significant in both the first and second testing. Although there seems to be some slight tendency for the underdeveloped cultures (Mexican, Eskimo, and Negro) to improve on the second testing, the difference was not significant. In fact the results indicate that there are two clusters of scores: the first is composed of the students of the middle class and the second the students of the underdeveloped cultures.

The fact that the two clusters remained significantly separated on both the first and second testing indicates that the differences can not be attributed to the skill level of the individuals, or if the difference is attributed to the skill level, then the practice given in the study was too short or ineffective.

An evaluation of the correlation between the tests and achievement ratings indicated that the middle class and the Eskimo groups both gained in predictive efficiency but that the Negro and Mexican groups lost. These correlations fail to offer support to the basic hypothesis of the study that practice in test-taking activity will increase the predictive ability of the test.

The study points to some striking and significant similarities among the underdeveloped cultures on this test performance. The three culture groups - Eskimo, Mexican and

Negro - form a cluster, and were found to be not significantly different from each other in either the first or second testing.

Two major theories advanced to account for racial differences are genetic and/or environmental. The first theory, which has been a controversial topic for the last several decades, suggests that certain racial groups are inherently genetically inferior in intellectual ability. The environmental theory stresses the early learning and environmental and experiential deprivation of the racial groups. It is, of course, most probable that some interaction of these factors, genetic and environmental account for differences between racial and ethnic groups.

It is not inconceivable that the Eskimo, who is isolated in the northern regions of our hemisphere, has learned traits and behaviors necessary to his survival but different from those learned by the student from the American middle class. Formal education is relatively new to the Eskimo culture and has not become a part of the prerequisites of success as it is in the southern provinces and the United States. The skills that the Eskimo child values are those derived from his culture, his future vocational choice and the real world of his parents. It is therefore not surprising that he may not have acquired the academic skills, or even be overly interested in acquiring the academically oriented skill of perception, the use of this type of feedback, or the drive to excell in these skills.

The Mexican culture differs markedly from the United States middle class. In fact, the middle class of Mexico would be considered a deprived and impoverished group in the United States. Perhaps the most startling finding was the lack of books in their schools. Except for the government-furnished

textbook (all courses are bound in one book), the average child has no access to printed material.

The Mexican culture supports dependency in children and the strong ties to the family are generally maintained into adulthood. Many of the factors which correlate with intelligence in the United States are low in Mexico, i.e., socio-economic level, early independence training, number of books available and adult interest in intellectual activities. Perhaps the combination of these variables has limited the Mexican child in his pursuit of learning skills.

The most difficult finding to understand is the position of the Negro child. His mean score on Form A is the lowest and is only mid-way between the Eskimo and the Mexican on Form B. The school of the Negro children in this study was comparable to that of the middle class school; the room was uncrowded and adequately supplied with books and reference materials.

The cultural differences between the Negroes and the middle class seem to fall into two general areas -- those associated with the socio-economic level and those related to their self attitude. Socio-economic level has been studied extensively. The findings continually indicate that socio-economic level is related to tested intelligence. Perhaps our test differences were in part related to socio-economic differences.

The limitations of the lower socio-economic level home involve the amount of reinforcement the child receives for exploratory behavior as opposed to inhibitory behavior. Another area of learning which seems directly related to lower

socio-economic level is the amount of exposure the child has to the adult. Recent studies (Karp and Sigel, 1964) have placed extreme importance upon imitation learning which takes place during early childhood. In the Negro homes, where the father is often gone and the mother works, the child is deprived of these learning opportunities.

The problem of identity and self esteem for the Negro child in the United States culture is serious. The mass media, books, magazines and movies typically depict the white child or adult as the image of success but offer little information and few identification figures for the Negro child.

This study found correlations between tested intelligence and achievement ratings ranging from .29 to .59. These correlations are within the range that group tests have consistantly been found to predict academic achievement.

Two other approaches have been proposed to predict academic ability. First, the construction of cultural-specific tests. This approach has not been fully developed because of the lack of trained personnel in the culture and/or the lack of sufficient knowledge of the group. There is little evidence to indicate that such an approach would lead to any significant increase in the prediction of academic ability. The second approach has been the development of the mental abilities tests. However, these tests suffer the same limitations as tests of general ability in administration and

applicability. They are further handicapped by specific training and environmental cultural limitations. These tests capitalize on differences between cultures and thus may prove valuable for diagnostic evaluation, but they lack the predictive value of tests of general mental ability.

Another area that seems fruitful to evaluate in relation to intelligence and academic achievement is the schools and the method of academic instruction. A number of authors have suggested basic changes in the education of the underdeveloped cultures. The schools, however, are controlled by adult members of the major cultural group and in nations such as Mexico and northern Canada have strongly inbred traditions of the old culture. The younger and more progressive teachers often find that they cannot stand up to the entrenched beliefs of the older, more conservative teacher and administrator.

The limitations of the teacher in the Negro school seems equally frustrating. The teacher in this case is generally of the middle class and thus her experiences, habits and background are different than that of the student. The differences have often led to an alienation of the student with the school.

In the United States a recent attempt has been made to change the cultural patterns of the lower class in preschool programs. However the effects of this peripheral training are easily dissipated and, of course, have little transfer to the daily life experiences within the subculture. Perhaps the

programs are too new to properly evaluate, but the results at this time appear disappointing.

The one successful method of assisting underdeveloped nations seems to be the traditional method of educating the upper strata and allowing this change to filter down. In the Negro subculture this method has alienated the educated few from the subculture and has failed to obtain a place for them in the larger middle class. Perhaps with the improvement in technology, communications, and human resources new methods of attitude change and evaluation will evolve to bridge the gap between the culturally disadvantaged and the dominant middle class.

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APPENDIX A

Items discarded because of high similarity to other items, identified by Raven Matrix number.

A7	D1	I3
A8	D4	I4
	D11	
B3	D12	II8
B12		II10
	E1	II16
C5	E6	II24
C11	E7	II25
	E10	II34

APPENDIX B

Items matched as equal in difficulty and the percent agreement among the 67 students.

Items matched		Percent agreement
A1	A2	84
A3	A4	92
A5	A6	84
A9	A10	90
A11	A12	80
B1	B2	90
B4	B5	86
B6	B7	82
B8	B9	82
B10	B11	80
C1	C2	74
C3	C4	84
C6	C7	78
C8	C9	86
C10	C12	84
D2	D3	80
D5	D6	86
D7	D8	78
D9	D10	76
E2	E3	78
E4	E5	76
E8	E9	78
E11	E12	78
I1	I2	74
I5	I6	72
I7	I8	72
I9	I10	76
I11	I12	82
II1	II2	78
II3	II4	82
II5	II6	82
II7	II9	74
II11	II12	74
II13	II14	78
II15	II17	72
II18	II19	72
II20	II21	78
II22	II23	78
II26	II27	76
II28	II29	80

APPENDIX C

Final Forms of the Experimental Scales identified by Raven item number.

Form A	Form B
A1	A2
A3	A4
A5	A6
A9	A10
A11	A12
B1	B2
B5	B4
B7	B6
B9	B8
B11	B10
C1	C2
C3	C4
C7	C6
C9	C8
C10	C12
D3	D2
D5	D6
D7	D8
D9	D10
E3	E2
E5	E4
E9	E8
E11	E12
I2	I1
I6	I5
I8	I7
I10	I9
I12	I11
II1	II2
II4	II3
II6	II5
II9	II7
II12	II11
II14	II13
II17	II15
II19	II18
II21	II20
II23	II22
II27	II26
II29	II28

APPENDIX D

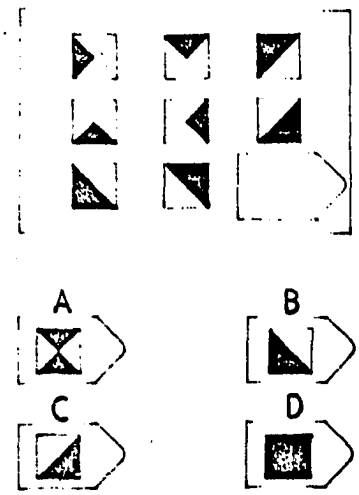
Item and foil selection for each Form of the Experimental Scales

Form A Item No.	Answer	Foil 1	2	3	Form B Item No.	Answer	Foil 1	2	3
A1	4	2	3	6	A2	5	1	2	3
A3	1	3	2	4	A4	2	3	4	5
A5	6	1	4	5	A6	3	1	2	6
A9	1	4	5	6	A10	3	1	5	6
A11	4	1	2	5	A12	5	3	6	1
B1	2	1	5	6	B2	6	1	2	3
B5	1	3	4	5	B4	2	1	4	6
B7	5	1	4	6	B6	3	2	4	5
B9	4	1	2	6	B8	6	3	5	2
B11	4	5	6	1	B10	3	1	2	5
C1	8	2	5	4	C2	2	3	7	1
C3	3	2	7	6	C4	8	1	3	4
C7	5	1	3	4	C6	4	5	1	3
C9	7	1	3	8	C8	1	2	7	4
C10	6	1	2	8	C12	2	1	5	4
D3	3	1	6	4	D2	4	1	3	6
D5	8	1	2	4	D6	6	1	2	3
D7	5	2	8	1	D8	4	1	2	5
D9	1	2	4	3	D10	2	6	5	7
D3	8	2	1	5	E2	6	3	7	4
E5	1	2	7	4	E4	2	4	5	6
E9	3	1	5	7	E8	6	3	4	2
E11	4	6	8	2	E12	5	2	6	8
I2	4	6	7	5	I1	8	4	3	1
I6	5	2	3	4	I5	2	3	7	4
I8	3	4	5	6	I7	6	5	4	1
I10	8	5	6	7	I9	7	3	8	5
I12	6	1	4	8	I11	7	3	4	6
II1	5	1	4	7	II2	1	2	5	6
II4	4	3	5	2	II3	7	5	8	1
II6	1	4	7	6	II5	3	1	2	4
II9	8	3	4	5	II7	6	2	1	4
II12	6	7	4	1	II11	5	3	4	1
II14	1	4	8	5	II13	2	7	6	5
II17	6	3	4	5	II15	2	4	5	6
II19	3	5	7	8	II18	7	1	2	4
II21	8	1	4	2	II20	8	2	4	7
II23	6	3	8	5	II22	7	4	5	1
II27	7	5	8	4	II26	2	5	6	8
II29	6	2	3	7	II28	5	2	3	7

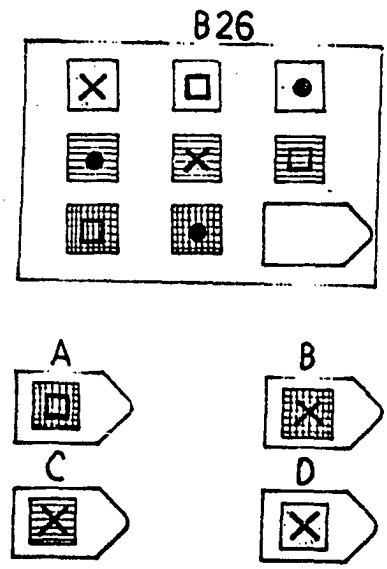
APPENDIX E

Sample of items included in the final test.

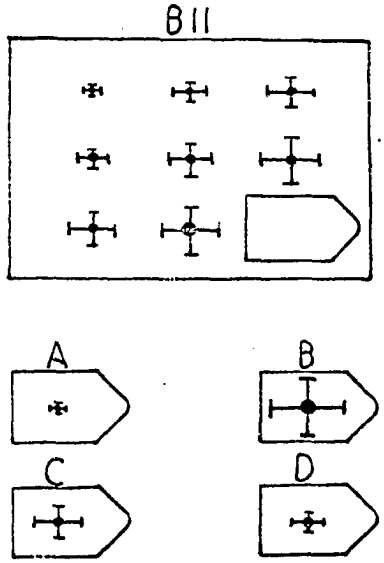
A32



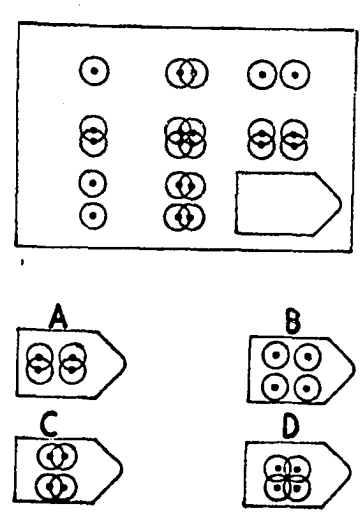
B26



B11



A15



APPENDIX F

Number of correct responses on the Experimental Raven Matrices by form and item. n = 56

Item	Form A	Form B
1	54	55
2	55	55
3	56	55
4	55	55
5	42	37
6	55	53
7	53	51
8	33	46
9	43	44
10	53	53
11	55	50
12	52	47
13	50	46
14	41	27
15	20	10
16	2*	52
17	50	49
18	48	40
19	36	35
20	30	26
21	14	25
22	14	19
23	7*	18
24	52	52
25	48	45
26	37	50
27	44	31
28	24	12
29	46	43
30	42	40
31	5*	37
32	39	38
33	37	27
34	32	23
35	32	24
36	30	28
37	12	28
38	16	10
39	16	11
40	11	10
Total	1441	1457
Mean	36.03	36.43

*Error.

APPENDIX G

Instruction for Cross Cultural Research:

The cross cultural research project consists of 3 tests. 1 - An Arithmetic test, 2 - Form A Matrix, 3 - Form B Matrix.

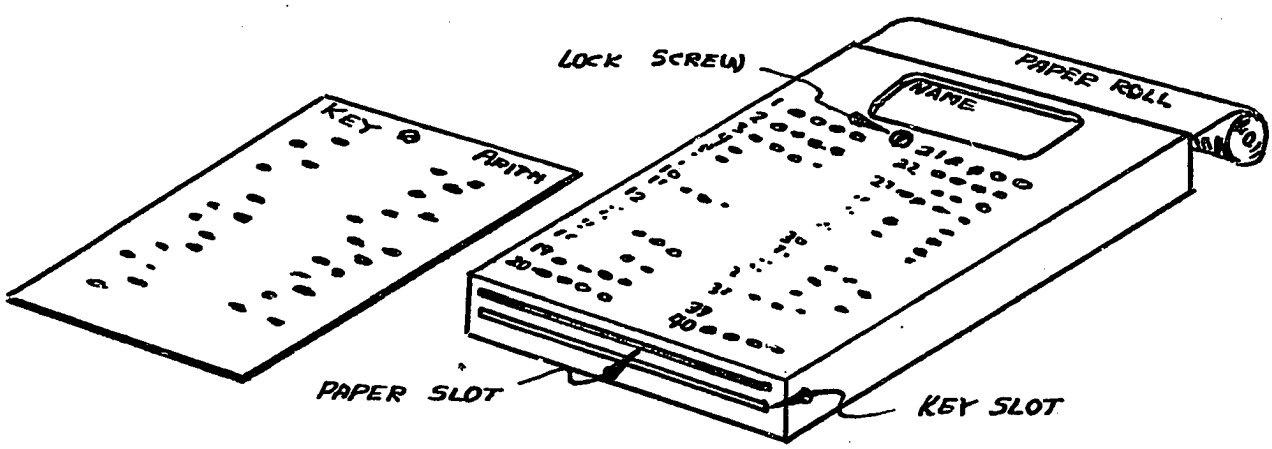
The tests should be given on 3 consecutive days, if possible on Tuesday, Wednesday and Thursday. Arithmetic test on Tuesday, Form A of Matrix test on Wednesday and Form B of Matrix test on Thursday.

The attached sheets of Students Record should be completed by the teacher giving date of birth, average achievement level for most recent testing in subject areas of language, reading, arithmetic, and composite or average.

Part I Arithmetic Test

The Arithmetic test is an adaption of the Wide Range Achievement Test, for use on the Answer Boards.

The Answer boards should be checked to insure the correct key is in place. Key-Arith is used for this section.



The key is placed in the bottom slide of the Answer Boards.

The scoring sheet is placed in the upper slide, it is easier to insert it from the top and tear along the sharp edge of the top.

After the key and the score paper has been properly inserted the lock screw is replaced which secures both the key and score sheet.

The operation of the Answer Boards is accomplished by the use of a pencil. The answer to the problem is selected as either A, B, C or D and the student attempts to insert the pencil in the hole of his choice. If the pencil extends deep into the hole the answer agrees with the key and the student should proceed on to the next question. If the pencil is stopped by the key and does not extend deep into the hole, the answer the student has chosen is in correct and he should try another answer for this question proceeding in this manner until he obtains the correct answer.

Instructions to the Student

Explain to the students that the machines have two functions
1 - They help the student learn because they tell him when he has the correct answer.
2 - They keep track of his work by the number of punches necessary for him to reach the correct answer.
The student should write his name and school, age and sex in the blank space at the top of the answer board.

The Arithmetic test is designed to allow all the students to correctly answer the first questions and the teacher should

assist any student who needs help in the operation of the machine.

Part II. Form A of the Matrix Test

Form A of the matrix test is given on the second day. The keys for the machines must be changed with key A placed in the top position. New paper must be added as described in the initial instructions.

The test consists of the first 40 slides in the corasel and are marked A1, A2, . . ., A 40. The projector should be placed in such a position that it will project a non-glare image that can be seen by all students.

The slides are presented in order starting with A1 allowing sufficient time for all students to work through to the correct answer. I have asked the students to hold their pencils in an upright position on the corner of their desks to indicate they have finished. With a quick glance about the room one can determine if every one has finished.

After all forty items have been completed in this manner. The Auto-learn machines are collected.

The Machines should be disassembled

1. Removing the lock screw,
2. Removing the used answer sheet carefully to avoid tearing (Place in envelope)
3. Remove the key plate
4. Reinsert the key plate for B. B should be placed on the top right hand side.

5. Insert new answer sheet from roll.
6. Replace lock screw.

Part III. Form B Matrix Test

Form B of the matrix test is administered in the third day. It is administered exactly like Form A.

The instructions for Form A should be reviewed if you have any doubt in the procedure.

Upon completion of the forty items the auto-learn boards should be collected. Procedure for disassembling.

1. Remove lock screw.
2. Remove the used answer sheet using care not to tear and place in envelope provided.
3. Remove key plate.
4. Reinsert the key plate for Arith.
   Arith. should be in the top right side.
5. Insert new answer sheet from roll.
6. Replace lock screw.

APPENDIX H

U. S. Negro

Subject	Test Form A Correct	Test Form A Errors	Test Form B Correct	Test Form B Errors	Rating Achievement
1	11	94	14	87	5.5
2	17	86	23	75	6.0
3	25	74	28	63	6.5
4	19	73	21	70	5.5
5	24	77	21	80	6.0
6	12	99	15	94	6.0
7	15	92	11	107	5.0
8	21	65	24	63	6.5
9	23	71	25	68	6.5
10	20	85	22	70	6.0
11	14	83	19	80	6.0
12	16	86	21	74	5.5
13	36	43	32	48	6.0
14	17	84	23	76	6.0
15	18	81	28	70	5.5
16	28	57	31	55	7.0
17	21	70	18	83	5.5
18	18	78	33	55	5.0
19	23	70	25	66	4.0
20	23	78	26	66	4.0
21	19	74	23	72	3.8
22	20	77	23	72	5.0
23	21	75	20	79	5.0
24	21	78	24	70	5.0
25	23	75	19	78	4.0
26	7	108	14	95	3.8
27	21	79	29	66	4.8
28	30	57	26	67	5.0
29	14	93	7	114	3.5
30	10	90	18	89	3.2
31	13	90	18	80	3.8
32	10	99	24	69	3.8
33	24	75	25	66	5.0

Mexican

Subject	Test Form A Correct	Test Form A Errors	Test Form B Correct	Test Form B Errors	Rating Achievement
1	15	93	28	56	6.0
2	0	160	27	69	7.0
3	28	59	28	56	7.0
4	26	66	22	78	8.0
5	28	53	28	53	8.0
6	18	81	28	70	6.0
7	22	70	14	89	6.0
8	21	70	14	89	6.0
9	26	65	24	70	7.0
10	22	72	26	68	6.0
11	28	60	25	61	7.0
12	11	97	13	99	7.0
13	15	91	9	99	7.0
14	21	77	26	65	8.0
15	8	105	22	79	5.0
16	28	57	31	55	8.0
17	21	73	27	60	7.0
18	21	74	28	59	7.0
19	36	43	27	63	8.0
20	27	64	30	54	7.0
21	20	83	21	73	8.0
22	33	49	23	71	7.0
23	26	63	22	57	6.0
24	26	68	19	79	6.0
25	28	62	32	54	7.0
26	17	85	22	74	7.0
27	12	99	17	83	6.0
28	19	70	14	85	7.0
29	24	77	28	66	9.0
30	21	65	18	71	6.0

U. S. Middle Class

Subject	Test Form A Correct	Test Form A Errors	Test Form B Correct	Test Form B Errors	Rating Achievement
1	25	75	20	78	5.0
2	32	50	30	53	6.4
3	25	69	26	61	6.3
4	33	50	31	51	7.3
5	34	49	31	53	8.9
6	33	47	37	43	6.5
7	37	43	34	46	6.8
8	35	45	25	66	7.9
9	35	46	29	58	5.7
10	33	49	31	54	6.5
11	30	55	36	48	6.4
12	27	63	30	57	6.9
13	31	57	37	43	8.2
14	28	58	32	55	6.8
15	29	55	28	59	6.5
16	37	43	32	58	7.2
17	34	47	35	46	7.3
18	36	46	37	46	6.5
19	33	50	37	44	7.6
20	32	52	33	50	7.3
21	30	56	35	48	7.8
22	39	41	31	50	7.6
23	39	4;	32	52	7.4
24	32	51	36	47	9.3
25	24	73	28	66	7.4
26	24	64	24	70	7.2
27	37	43	31	53	7.8
28	31	63	27	60	7.3
29	20	83	25	72	5.9
30	34	48	28	59	4.6
31	28	57	26	68	6.6
32	35	48	32	52	8.5

Eskimo

Subject	Test Form A Correct	Test Form A Errors	Test Form B Correct	Test Form B Errors	Rating Achievement
1	10	100	15	88	3.0
2	27	66	22	75	4.0
3	18	84	24	72	3.0
4	22	84	24	72	3.0
5	16	96	20	83	4.0
6	20	91	21	72	4.0
7	20	80	27	68	4.0
8	17	80	22	66	3.0
9	12	92	16	82	3.0
10	15	85	11	84	2.0
11	23	75	28	59	3.0
12	24	71	22	71	4.0
13	23	73	23	68	4.0
14	20	80	23	78	4.0
15	14	90	10	96	2.6
16	27	73	20	76	2.6
17	7	84	8	95	2.6
18	25	65	25	59	2.6
19	36	50	32	57	4.0
20	21	76	22	73	4.0
21	28	65	31	56	4.0
22	28	60	23	73	4.0
23	10	108	6	102	2.6
24	27	64	28	62	4.0
25	33	79	30	52	3.0
26	26	62	26	62	4.0