AN ASSESSMENT OF THE USEFULNESS OF THE WARTEGG DRAWING COMPLETION TEST AS A CROSS-CULTURAL NON-LANGUAGE PREDICTOR OF ACADEMIC ACHIEVEMENT AMONG ELEMENTARY SCHOOL CHILDREN IN GUATEMALA

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ABSTRACT

AN ASSESSMENT OF THE USEFULNESS OF THE WARTEGG DRAWING COMPLETION TEST AS A CROSS-CULTURAL NON-LANGUAGE PREDICTOR OF ACADEMIC ACHIEVEMENT AMONG ELEMENTARY SCHOOL CHILDREN IN GUATEMALA

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The Problem

The existing limited school facilities in developing countries could be used more efficiently by admitting only students that have high achieving potential. Selection of such students could probably be accomplished by administering a group, cross-cultural, non-language test. Several recent studies suggested that the Wartegg Drawing Completion Test (DCT) seemed to fulfill the criteria needed for such a test. The main purpose of this study, therefore, is to test the predictive validity and reliability of the DCT.

The Sample

A total sample of 283 second-grade subjects was obtained from 16 randomly selected public schools in four counties of different geographical areas of Guatemala, Central America.

Methodology

The data was collected by administering the Wartegg Drawing Completion Test under standard conditions, by classrooms, at randomly selected schools, to all second-grade students.

The tests were scored individually by means of a new scoring scale. The validating criterion (mean mid-year grades) was obtained from the official school-records.

The resulting data were coded and punched on I.B.M. cards and processed through the CORE programs at the Michigan State University Computer Laboratory.

Results and Conclusions

1. The Wartegg total score, as tested by the Ebel method, is well within the expected levels of reliability (.99--see Appendix F). However, correlations between Wartegg total scores and its sub-tests did not reach the established levels for intra-test reliability.
2. The predictive ability of the DCT for the selected validation criterion (mean-class-grades) is very low. However, results also indicate that the reliability of the criterion, as a measure of academic achievement, is also low.
3. Significant differences between urban and rural school children's scores on the Wartegg total and its parts

were found. Rural children score lower than urban children.

4. Significant differences in mean class-grades between urban and rural children were found. Rural children grades are lower than those of urban children.

5. Due to certain limitations in this study, further tests of validity and reliability of the Wartegg Test, incorporating several changes, are recommended.

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CHAPTER I

INTRODUCTION

The Problem

The present research is part of a larger project being conducted in different cultural regions of the world and is based on several previous studies which appeared to indicate that the Wartegg Drawing Completion Test (DCT), with some improvements in its scoring system, could be used as a cross-cultural, non-language measurement of academic achievement. If the test could be so used, it would be an important contribution toward the improvement of education in developing countries.

A Unesco report, The World Survey of Education II (26:15), states that in the period from 1950 to 1954 there were a total number of 550 million children between the ages of 5 to 14 years in the world. Of these, only 300 million were enrolled in primary or secondary schools. This means that only slightly more than one-half of the world's children are receiving some kind of education in schools today. Of these 300 million, a large number drop out after one or two years of school. Therefore, a considerable proportion of those who do go to schools, particularly in rural areas, do not attend long enough to insure permanent functional literacy. Of the total primary school-age population of over 260 million, only 70.9 (21%) reach secondary school. It seems, therefore, reasonable that the developing countries might make better use of their limited primary school facilities by admitting only those that obtain the highest scores on a test which predicts academic achievement.

The Nature of the Problem

In Guatemala, the present situation of education is even more serious than the average in the rest of the world. Seventy-five per cent of its total population above 14 years of age is illiterate and the population, as a whole, is increasing at an annual rate of 3% (9:35).

The school-age population is increasing at a much higher rate. It has gone up almost 200% in the last twenty years: from 427,000 in 1940 to 779,000 in 1960 (10:63).

In 1940, 296,000 children were unable to attend school because of lack of space. In 1960, there were 482,000 children in the same situation. The absolute numbers keep increasing as indicated in Table 1.

Table 1 also includes data about the total number of children in-and-out of schools during a four year period, and the breakdown between urban and rural schools.

In 1960 it was estimated that 11,800 more classrooms with furniture and equipment were needed to accommodate all

TABLE 1.--Estimated school-age population (7-14 years) and the total number registered in schools (10:64).

Population	1957	1958	1959	1960
Total population	679,038	696,902	707,344	779,100
Total registered in day primary schools	249,832	259,890	281,950	297,009
Urban schools	153,788	161,168	174,659	185,323
Rural schools	96,044	98,722	107,291	111,686
Total number out of schools	429,206	437,012	425,394	482,091

school-age children in the country at that time. Since every classroom needs a teacher, there was also a shortage of 11,800 teachers (3:154). The total cost to the nation to fill this need would amount to a 300% increase in its present annual budget.

The country does not have the capital to finance such an educational program in the near future, since the population keeps increasing every day and the annual income (per-capita) is low: $174.89 in 1960 (3:10). Table 2 shows the efficiency of Guatemala's educational system during the last decade.

During the 1950 to 1960 period, 525,500 children registered in first grade. Of these, only 93,500 finished sixth grade, which is the official completion of primary

TABLE 2.--Distribution of school-age children (6-13 years) according to probable levels of instruction in 1960 (4:6).

Distribution	Absolute Number (in thousands)	Relative Percentage of School Age Children
Total school-age population	779.1	100
Absolute illiterates	504.9	65
Potential illiterates	168.8	22
In school	83.8	11
Out of school	85.0	11
Deficient literates	50.4	6
In school	25.0	3
Out of school	25.4	3
Satisfactory literates	55.0	7

school in Guatemala. This is only 17.8% of the total number that started school (4:7). One of the main reasons for this loss is that many children register but never attend classes as is shown in Table 3. Of those that do attend, the highest percentage drop out in the first three years. In 1961-1962 the percentage of dropouts in first grade was 49.47% (10:64-75). According to the report of the Commission of the Economic Planning Council (3:61-72) a high percentage of those who drop-out are students who fail grades or have low academic achievement.

TABLE 3.--Registration and mean attendance in primary school in 1962 (10:65).

	Registration			Mean Attendance		
	Male	Female	Sum	Male	Female	Sum
Total	189,321	149,532	338,853	158,903	125,489	284,392
Rural	78,082	52,371	130,453	63,172	42,228	105,400
Urban	111,239	97,161	208,400	95,731	83,261	178,992

Of a total of 338,800 students who registered in 1962, only an average of 284,400 attended classes. Table 3 also shows that the average attendance is lower in rural than in urban schools.

All evidence reviewed so far seems to indicate that in the foreseeable future only a portion of the total school population in Guatemala will find a place in school. Therefore, every effort should be made to increase the efficiency of the limited resources available. This could be accomplished, at least in part, by admitting to school only those students who seem to have the potential to be good academic achievers. This selection could be accomplished through a combination of school-grades, teacher ratings, and test scores made at the beginning of the second school year. The screening test could be used as an entrance test to the second year, and its results could be used in conjunction with the child's grades and teacher ratings in the first grade.

An efficient screening test for these purposes would have to meet the following criteria. The test should be:

1. a group test that can be easily administered and scored, because the number of children to be tested is large;
2. a non-language test, because Guatemalan children speak different languages and dialects, and at those ages they are still unable to read fluently;
3. a "culture fair" test, because it has to include only those cultural elements common to the heterogeneous cultural groups in the country;
4. a low cost device, because the educational system operates on a very limited budget;
5. a good discriminator of children's academic abilities, because its main purpose is to separate children according to their differing degrees of ability; and
6. a good predictor of children's future academic achievement.

A test, which at least "a priori" seems to meet most, if not all, of the above-mentioned criteria, is the Wartegg Drawing Completion Test.

The Instrument

The prototype of the Wartegg Drawing Completion Test, as a projective technique for personality assessment, was originally constructed by Sander at the University of

Leipzig and was known as the Phantasie Test (14:3). The present form of the test, based on Sander's work, was constructed by Wartegg (27, 28, 39, 30).

In 1952, Kinget introduced the Wartegg test to the United States. She had previously conducted research, involving 383 adult subjects, using the Wartegg Test for her doctoral dissertation in Belgium. She developed a scoring system to aid in the interpretation of the drawings. Her system scores personality on four components: emotion, imagination, intellect, and activity (14:9-10). Based on the work of Kinget, Stark (24), Keith (12), and Matheney (19) developed, tested, and suggested a new scoring system in order to use the Wartegg Drawing Completion Test as a test of intelligence.

The DCT blank, as used in the present study, is presented in Appendix B. It consists of eight frames encased in a heavy black border arranged adjacent to each other on the upper half of the form. Within each frame there is a different stimulus of very small dimension. The characteristics of the stimuli that appear in the eight frames have been described by Kinget as follows:

> <u>Stimulus 1, the dot</u>, represents smallness, lightness, circularity and centrality. The stimulus itself is not imposing and could be omitted by the less sensitive or perceptive subject.
>
> <u>Stimulus 2, the wavy line</u>, suggests something alive, mobile, loose undulatory, fluid or growing. The qualities of this stimulus resist matter-of-fact treatment or technical use. It required integration into something organic or dynamic.

Stimulus 3, the three vertical lines with proportional increments, express the qualities of rigidity, austerity, regularity, order, and progression. These qualities can be combined and can produce complex impressions of dynamic organization, gradual development, methodic construction, and similar concepts.

Stimulus 4, the black square, looks heavy, solid, massive, angular, static, and evokes concrete materiality. While Stimulus 3, in spite of its mechanical nature, still shows some growth and dynamism, Stimulus 4 is completely inorganic and inert.

Stimulus 5, two slanted lines in opposite directions, express the idea of conflict and dynamism. The position of the longer line evokes something directed decidedly upwards to which the shorter line shows frank opposition. The rigidity of the lines and their perpendicular relation also suggests their technical or construction use.

Stimulus 6, the horizontal and vertical lines, have a strictly matter-of-fact, sober, rigid, dull and uninspiring aspect. At first sight they seem fit only for completion into simple geometric patterns or elementary objects. Experience shows, however, that this stimulus may be worked into a variety of interesting combinations. However, the off-center position of each of the lines makes their completion into a balanced whole, a tough task requiring considerable planning activity.

Stimulus 7, the dotted half circle, suggests something very fine, delicate, round and supple, that is at the same time both appealing and a little puzzling because of its complex bead-like structure. This structure-like aspect of the stimulus, together with its somewhat awkward location within the square, forces the selective activity of the mind and resists casual or crude treatment.

Stimulus 8, the broadly curved line, has the organic qualities of roundness and flexibility of Stimulus 7, but whereas Stimulus 7 has something irritating in its complexity and smallness, Stimulus 8 appears restful, large, fluent, and easy to deal with. Its smooth curve readily suggests completion into organic subject matter, animate or inanimate, while its downward bending movement and location connote the idea of cover, shelter, and protection. Its relatively large dimension also evokes expansion and vastness as proved by the frequent completion of

> this stimulus into natural phenomena such as rainbows or sunsets (14:35-37).

Though these stimuli emphasize the measurement of personality, the DCT can also measure intelligence as will be described in Chapter II while the DCT's scoring system, as used in this study, will be described in Chapter III.

Reasons for the Study

Some of the most serious educational problems being confronted by Guatemala at the present time have been presented in previous pages of this thesis. The great disparity of cultural and sub-cultural groups in the country, the great variety of languages and dialects spoken by rural school children, the limited educational facilities, and the high number of school drop-outs among low academic achieving children, indicated the need for an instrument which can differentiate children of high and low academic ability. This could probably best be accomplished by a group test. The ideal tool to accomplish this task would be a culture-fair, non-verbal, economical, and simple test (to administer and score) that would make possible such differentiation among eight to ten year old children, an age at which children initiate their schooling in Guatemala.

The DCT appears to be such an instrument. It is a relatively culture-free test because it does not include typical elements of a certain culture at the expense of children of other cultural groups. It is a non-verbal, graphic test that circumvents the problem of different languages and dialects. It does not require that children be fluent in Spanish in order to perform well on it. Since the DCT is a graphic test it does not require that the subjects know how to read and write. This is very important because the children proposed for the Guatemalan sample have not yet learned how to read and write.

The test is so simple to administer and score that primary school teachers, with some training, could administer and score it. The test's directions are sufficiently simple that first-grade children can follow them. The DCT is also economical because it is a group test that can be given simultaneously to a whole class, consists of only a sheet of paper, is administered in approximately forty minutes, and its objective scoring system is such that it requires only a few minutes to score each test.

A careful survey of all research publications both in Guatemala and the United States indicates that no previous research has been conducted with the DCT as a predictor of pupil academic potential in Guatemala. The purposes of the present study are:

1. To test the reliability of the DCT as a measuring instrument.
2. To determine if there is any significant relationship between the DCT test scores and the student's mean grades.

3. To determine the validity of the DCT in predicting future academic achievement of students starting their primary education.

Limitations

This study has been designed in such a way that the stratified random sample would include a representative number of cases in three areas, with different population densities, of second-grade children in official Guatemalan day schools during the 1963 school year.

The three areas included in the sample are:

1. Rural area--This includes public, primary, coeducational day schools found in villages with less than 1,000 habitants.
2. Semi-urban area or towns--includes public, primary, coeducational day schools found in small towns with a population of 1,000 to 5,000 habitants.
3. Urban area--includes public, primary, coeducational day schools found in towns with a population of 5,000 or over.

Since all schools sampled are coeducational, there is almost an equal number of boys and girls included in this study: 157 boys and 126 girls. It is neither the intention nor the purpose of this study to standardize the DCT for Guatemalan public schools. Therefore, no generalizations, at a national level, should be made on the basis of this sample. Although there is a considerable range in ages of children included in this sample, no age norms for children can be established from this data. These age distributions are not normal; in all probability "brighter" than normal children would be found at lower ages and a greater number of "duller" than normal children would be found at older ages since the children sampled are all in the second grade.

Guatemala's educational system does not place emphasis in promoting children on the basis of chronological age. Children of low ability frequently repeat first and second grades and, therefore, "duller" than normal 9, 10, and 11 year old children are found in the second grade. For the same reason, "brighter" than normal seven year olds are found in second grade because they are the ones that have started school early and have not failed the first grade. The generalizations that can be made, based on this study, are only with reference to the characteristics of second grade children found in rural, semi-urban, and urban public, primary, coeducational Guatemalan day schools in 1963. These generalizations can be made in regard to academic achievement, DCT scores, and distribution of ages and sexes at the second grade level.

Organization of the Thesis

Chapter I, the introduction presents the educational problems faced by the developing countries of the world today, including those faced by Guatemala. The statement of the problem, reasons for the study and its limitations are included in this section.

Chapter II, the related research is reviewed, placing special emphasis in reviewing the research that has been published on the Wartegg Drawing Completion Test.

Chapter III, the method used for sample selection, data collection, hypotheses to be tested, the scoring system, test administration, and statistical analysis are described in this chapter.

Chapter IV, an analysis of the data, using appropriate tables to aid the interpretation, is given here.

Chapter V, a summary of the obtained results, conclusions that can be drawn, and recommendations for further research are presented in this section.

CHAPTER II

RELATED RESEARCH

Interest in children's drawings as a means of measuring general ability can be traced to the year, 1885, when Cooke (5) published an article in which he described the different stages of intellectual development shown by the drawings of children. From 1900 to 1915, Lamprecht (17) of the University of Leipzig collected drawings of children from all parts of the world. Unfortunately, he never completed this research and, therefore, we do not have a summary of all the data that was gathered. Later, Kerschensteiner (13) conducted one of the most extensive studies in drawings of children. He gathered more than 100,000 and classified them in three categories:

1. Purely schematic drawings. These correspond to the so-called ideoplastic stage in which the child draws what he knows and not what he sees;
2. Two dimensional, visual appearance drawings; and
3. Three dimensional drawings, in perspective, in which the child tries to give the impression of three-dimensional space.

Kerschensteiner devoted several pages in his book to reporting the differences he had noted between high- and low-achieving school children. He discovered that there were quantitative and qualitative differences between these and that low achieving children make more primitive drawings than the others. Rouma (22) established many of these differences between the drawings of retarded and normal children.

Rouma also conducted other experiments in which he compared the drawings of European children with those of children in contemporary primitive societies. He found, among other things, that the order of development in children's drawings is astonishingly constant even among children of radically different social and cultural backgrounds. In all cultures that were studied, Rouma found that the first drawings children attempt are a graphical enumeration of things. At a later stage, they develop proportionality among the different parts and spatial relations among the different things. He also discovered that children of lower mental ability can imitate well but cannot produce good original drawings while mentally-gifted children show real creative ability in their drawings.

More recently, Gestalt psychologists have emphasized this type of research by stating that the basic personality structure of the individual can be inferred from his drawings. The Machover Test of the human figure (18) and the Buck House-Tree-Person Test (HTP) (2) are some of the tests designed for this purpose.

Several other studies have been conducted with the purpose of using the drawings as the basis to measure intelligence. Of these, the most widely known is undoubtably that of Goodenough which resulted in the "Draw-A-Person Test" (8). This test has demonstrated its usefulness as a nonverbal intelligence test.

Bender has tried to use drawings as an index of visual motor coordination development (1). Koppitz designed an efficient scoring system for this test (16). This system makes it possible to determine a development age. The scores on the Bender correlate fairly well with scores obtained by means of the Wechsler Intelligence Scale for Children (WISC) between the ages of 5 and 10 years (16:413-416).

Another exponent of Gestalt psychology, Sander of the University of Leipzig, constructed a prototype of the present Drawing Completion Test which he entitled Phantasy Test (23). Sander's work furnished the basis for that of Wartegg, one of Sander's colleages at the University of Leipzig (29). Wartegg is the author of the present form of the Drawing Completion Test which is known as the Wartegg Test.

Kinget (14) conducted a study in which she administered the Wartegg Test to 383 adult normal subjects and presented her results in the form of a doctoral dissertation at the

University of Louvain in Belgium. Kinget developed a relatively elaborate scoring system designed to aid in the interpretation of the drawings. According to Kinget's scoring system the Wartegg Test can be analyzed through four factors: emotion, imagination, intelligence, and activity (14:9-10). This evaluation system, which uses the Wartegg Test as a projective technique to analyze personality for clinical purposes, was introduced by Kinget to the United States in 1952. Since that date, interest in this test has continued to grow in the United States.

In a review of all publications appearing in the Psychological Abstracts the present writer was unable to find any study that used the DCT in an under-developed society. However, some studies have been conducted with the DCT with more than 2,000 children in developed countries. Two studies, one conducted by Erna Duhm (6) and the other by Hemmo Müller Suur (20) are listed in the Psychological Abstracts of 1953.

These researchers found that certain characteristics differentiate the drawings of children of high- and low-academic achievement within the same culture. The characteristics are:

a. Children of low academic achievement do not integrate the initial elements, given by the test form, in their drawings;

b. The same children show a marked repetition of simple graphic themes in each drawing; and

c. They alwo show a tendency to disregard or "burst" the spatial divisions of the tests.

Another study was conducted by Stark (24) at the University of Detroit in 1954. She suggested that the DCT could be scored objectively as an intelligence test. A Pearson product moment correlation coefficient of .79 was established between the DCT and the WISC scores, which seemed to confirm this fact. The evaluation system used by Stark was based to a great extent in the variables suggested by Kinget but she also added some others taken from the work of Goodenough. Her scoring system included the following variables: (1) orientation, (2) detail, (3) organization, (4) proportion, (5) dimension, (6) symmetry, (7) symbolism, (8) movement, (9) originality, (10) variety, and (11) time.

Matheny (19) investigated the usefulness of the DCT as an instrument to measure the general ability of fourth graders at Waverly School District in Lansing, Michigan. His sample includes 176 students in the fourth grade of elementary school. He divided the children, according to sex into a validation and a cross-validation group. Several comparisons were made between the scores obtained by the students in the DCT and in the Primary Mental Ability Test (PMAT), grade point average (GPA), and their Stanford

Achievement Test scores in arithmetic and in reading. The results showed that the DCT scores have a statistically significant relationship with the P.M.A.T., I.Q. scores, the Stanford's arithmetic and reading standard scores, and with grade-point averages. The DCT scoring variables that correlated best with the validation criteria are: dimensionality, proportionality, and detail.

Another study by Keith (12) presented the results of administering the DCT to school-age children of three sub-Saharan African tribes. He attempted to evaluate the academic achievement of 98 eleven-year old children in rural schools using the three scoring variables suggested by Duhm and Müller Suur in order to differentiate between the different levels of intelligence. These variables are: (1) integration of the stimulus in the drawings, (2) repetition of graphic themes, and (3) disregard for the spatial divisions of the test. Keith's sample was divided into high and low academic achieving students according to their grade point averages and teacher evaluations. He found that integration of the test-stimulus in the drawings contributed significantly to differences between the mean-scores of high and low academic achieving children. The two other variables did not contribute consistently to differenciate between the means of high and low achieving children of the African tribes that were studied.

CHAPTER III

METHODOLOGY

The Sample

A stratified random sample of coeducational public primary schools was used, and 283 second grade pupils were thus tested. In order to meet the necessary assumptions for a statistical interpretation of results, each school was assigned an identifying number, and a table of random numbers was run to select the schools in each stratified area. The sample is stratified according to the population density in the site where the school is located.

The sample included: (1) schools located in rural areas, i.e., schools found in villages of less than one thousand inhabitants; (2) semi-urban schools located in towns of more than 1,000 but less than 5,000 inhabitants; and (3) urban schools in towns of 5,000 inhabitants or over. Although this study did not aim to gather a nation-wide sample from which norms for all Guatemalan second-grade children could be established, nevertheless in order to avoid the urban cultural influence of the capital city, it seemed preferable to have samples from different parts of the country. Therefore, the sample includes schools of the extremes east and west of the country as well as from the south and center. (See map of population density and locations of counties included in this sample in Appendix A.) The selected schools from the stratified area are:

Urban:

1. José J. Palma, Guatemala.
2. Alejandro Marure, Guatemala.

Small city:

1. Santa Elena, Chiquimula.
2. José A. Palma, Chiquimula.
3. E. Palo Gordo, San Marcos.
4. El Salto, Escuintla.

Rural:

1. San Estan, Chiquimula.
2. El Ingeniero, Chiquimula.
3. Vado Hondo, Chiquimula.
4. Raúl Mejía, Chiquimula.
5. Chamac, San Marcos.
6. Champollap, San Marcos.
7. Federación, San Marcos.
8. Ixquihuila, San Marcos.

In several rural schools there were children from either first or third grade in the same room with the second grade pupils. With only two exceptions, the first or third grade pupils were asked to leave the room while the second grade subjects took the test. In these two instances, the test was also administered to the few (2 or 3) third graders, but their test sheets were later excluded from the sample.

In order to determine the location of the schools, to obtain the necessary data about them, and to insure the cooperation of principals and teachers for this study, it was necessary to visit the Technical Superintendent of Education of the county in which the schools to be included in this study were located. The Technical Supervisors agreed to sign a letter addressed to the primary school principals in their county, which asked them to cooperate in every possible way to make this study possible.

In all cases, supervisors, directors, and teachers were very courteous and willing to help. They permitted the tests to be administered upon appearance of the tester and provided all the additional information needed to complete the study. They also prepared a list with the pupil's name, age, sex, grade placement, and midterm grades in the four main academic subjects.

Hypotheses to be Studied

There are four hypotheses which were to be tested in this study:

Hypothesis 1: The Wartegg Drawing Completion Test is a reliable instrument. Therefore, the total score of the DCT is predicted by the independent variables (its sub-tests). The sub-hypotheses relative to this analysis are:

a. The number of dimensions score contributes significantly to the total score.

b. The number of objects in the drawings makes a significant contribution to the total score.

c. The number of drawings in which the stimulus was integrated contributes significantly to the total score.

d. The number of meaningful objects or drawings with meaningful lines makes a significant contribution to the total score.

e. The number of proportional drawings contributes significantly to the total score.

Hypothesis 2: The Wartegg Drawing Completion Test is a valid instrument for predicting academic achievement of second grade children. Therefore, a significant relationship exists between the Wartegg total score and its part-scores with second grade student's mean mid-year school grades.

Hypothesis 3: There is a significant difference between urban, town and rural school children scores on the Wartegg Drawing Completion Test.

(For the purpose of this study, urban children are those that attend public primary schools in Guatemala city (over 500,000 inhabitants); town children are those that attend public primary schools located in towns of 1,001 to 4,999 inhabitants; and rural children are those that attend public primary schools located in areas with less than 1,000 people in Guatemala.)

Hypothesis 4: There are significant cultural differences among Guatemalan school population which affect pupil's mean-grades and total and partial scores on the Wartegg Drawing Completion Test. These differences exist both between and within different geographical regions of the country.

(Cultural differences, for the purposes of this study, are those found between the "Spanish" or "Western" population which predominates in the urban sample of this study and the "Indian" population of Guatemala which predominates in the town and rural samples of this study. These differences include language, social, and religious customs, nutritional habits, living standards, and costumes.)

The Scoring System

The Academic Achievement Prediction Scale (AAPS) of the Drawing Completion Test is based on previous work done by Keith (12) and Matheney (19). Their recommendations concerning the improvement of the validity and the reliability of the tests scoring system were incorporated.

The scoring system appears in Appendix C. The eight frames of the test are scored separately on a 0 to 60 point scale. The highest possible score for any subject is 480, since a raw score of 60 can be obtained for each figure.

The scoring is performed according to the following directions:

1. Determine whether the drawings are one, two, or three dimensional in nature.
2. Determine the number of objects in each picture.
3. Select the appropriate column of dimensionality and correct row for none, one, two, or more objects, with or without background detail.
4. Determine integration of stimulus or non-integration of same.

5. Determine whether the drawing is meaningful or has meaningful lines.

6. Determine for or against proportionality of drawing.

Example:

A 3-D object with background detail.

1. Enter column 1, row 5 (counting upwards).
2. If the object is integrated, scores can range from 41 to 44.
3. If the object is not integrated, scores can range from 37 to 40.
4. If the object is integrated and meaningful, possible scores can be 43 or 44; 43 if not proportional, 44 if it is proportional.
5. If the object is integrated but not meaningful, scores can be 41 or 42.

In special cases additional scoring criteria is used: (1) two or more 2-D drawings which are simple stick drawings, score no more than single 2-D drawings; (2) minus one point for each repetitious theme drawn.

The terms used in the scoring system are defined by Matheny (19:41-42) as follows:

1. Dimensionality: Drawings may be classified as one, two, or three dimensional in nature. The properties of dimensionality are sufficiently well-defined as to make further definition unnecessary.

2. Integration: This variable is judged to be present when there is clear evidence that the subject

has taken cognizance of the stimulus in his drawing. The degree of integration is not considered at this point. The sole criterion is whether or not there is clear evidence that the subject has attempted to incorporate the stimulus into his drawing.

3. Meaningfulness: This variable refers to the ability of the drawing to convey something of a representational nature to the examiner. Since the child is not asked to verbally identify the drawing, meaningfulness must be inherent in the projected qualities of the drawing.

4. Proportionality: This variable refers to the relationship of the various parts of the picture to the whole. It depends exclusively upon the meaningfulness of the picture. Consequently, if a drawing is not perceived as having meaningfulness, there is no way of rating the degree of proportionality offered by the drawing.

5. Detail: Drawings which add ornamentation beyond what is necessary for clear recognition of the item represented are given credit for detail.

6. Repetition: Drawings which appear to be replicating a previous theme suffer a penalty of one point. In a sense, this is a reverse procedure for scoring variety of content. It appears to lend itself to objective scoring more fully than does variety as a scoring variable.

Administration of the Test

The DCT was administered to the subjects by units of classrooms. The following procedures and directions were practiced in order to insure uniformity:

1. Pupils were seated a suitable distance apart to render opportunities for "cheating" less likely.

2. The drawing blank was placed on a manila folder.

3. The subjects were furnished Number Two drawing pencils with uniformly sharpened points.

4. The following instructions, suggested by Kinget, were read to the subjects in Spanish:

> On this form you see eight squares. Each of these squares contains little signs. These signs have no special meaning; they are to be part of the drawings which I want you to make in each of the squares. You may draw whatever you like and you may start with the sign you like best. You may work as long as you wish, and you may use the eraser. Do not, however, turn the sheet. This must be the top (Examiner points) (45:28-29).

Whenever necessary, the instructions were repeated to help the pupils understand what they were to do. The time required for administering the test to an entire class ranged from 40 to 60 minutes.

Statistical Procedures

The reliability and validity of the DCT were first determined by computing multiple regression equations and analysis of variances for the entire sample of 283 subjects, using the CORE program of the Michigan State University Computer Laboratory.

The program includes the following computations:

1. Multiple regression equations with the total Wartegg score as the dependent variable and (1) dimensionality, (2) number of object, (3) integration, (4) meaningfulness, and (5) proportionality as the independent variables.

2. Multiple regression equations with the mean mid-year class grades as the dependent variable and the (1) total Wartegg score, (2) dimensionality, (3) number of objects, (4) integration, (5) meaningfulness, and (6) proportionality as the independent variables.

3. Analysis of variances with the mean mid-year class grades as the dependent variable and the different regions as the independent variables.

4. Analysis of variance with the mean mid-year class grades as the dependent variable and the different class groups as the independent variables.

5. Analysis of variance with the total DCT score as the dependent variable and the different regions as the independent variables.

6. Analysis of variance with the total DCT score as the dependent variable and the different classroom groups as the independent variables.

7. The ability of the DCT was further tested by the method outlined in Appendix E, which is a computation of reliability by analysis of variance.

Validating Criteria

In first and second grades, academic achievement is officially determined by mid-year and final grades assigned by the grade teacher. No official written tests are administered and there are no known standardized achievement tests in Spanish suitable for second grade Guatemalan pupils. Therefore, the validity of the Drawing Completion Test, as a predictor of academic achievement was tested against mean mid-year class grades in the second grade. The average mid-year grades in the main academic subjects: Spanish, Arithmetic, Natural Sciences, and Social Sciences constituted the criterion variable of academic achievement.

CHAPTER IV

ANALYSIS OF THE DATA

The statistical data for analysis are found in Tables 4 through 26. The data were coded according to a code book specifically devised for this purpose (see Code Book in Appendix D), and was key-punched in I.B.M. cards. The computations and card punching were performed by the Michigan State University Computer Laboratory.

Means and variances of Wartegg total scores were computed for (1) classroom groups, (2) urban, town and rural samples, and (3) geographical regions samples. These appear in Appendix E, Tables 21, 22, and 23. Analyses of variance were also computed for each one of these categories and the differences were found significant beyond the one per cent level. As shown in Tables 4, 5, and 6 (Appendix E), F values are 12.2 for classroom-groups, 24.2 for urban, town and rural groups, and 20.4 for geographical regions. Means and variances of mean-grades were computed for (1) classroom-groups, (2) urban, town and rural, and (3) geographical region samples (Appendix E, see Tables 24, 25, and 26). Analyses of variance computed for each one of these groups were found significant beyond the one per cent level. Tables 7, 8, and 9 (Appendix E) show their respective F values 5.6 for classroom-groups, 16.1 for urban, town and rural and 11.5 for geographical regions samples.

<u>Results of the Tests of Reliability</u>

Reliability is the consistency of measurement of a particular instrument. It can be tested statistically by means of several techniques. The techniques used in this study are (a) the part to whole correlation method and (b) the score-rescore correlation. Completion Test's total score was correlated with each one of its constituent sub-test scores. As shown in Table 11, a corrected multiple correlation coefficient of .5687 was obtained between the DCT's total score and its five sub-tests, with a .3234 coefficient of multiple determination.

Partial correlation coefficients, which appear in Table 12 reveal that Number of Objects and Integration make significant contributions to the total score but Proportionality, Dimensionality, and Meaningfulness contribute little to the total score.

With the exception of Dimensionality, all simple correlation coefficients between the Wartegg total score and its part scores were found to be statistically significant at the .05 level. These coefficients appear in Table 10, and emphasize that Number of Objects and Integration contribute substantially to the total score with coefficients of .44 and .32.

Beta weights were also computed for each of the part scores on the total score. Their values appear in Table 13. Again, Number of Objects and Integration appear to be the best predictors of the total score. Meaningfulness predicts the total score to a lesser degree and Dimensionality and Proportionality do not predict it at all. To conclude, this test of reliability indicates that the Drawing Completion Test is partially consistent as a measuring instrument.

The inter-scores reliability of the DCT was also determined. Simple correlations between scores and re-scores of the total and partial scores were computed for a randomly selected sub-sample of 50 subjects. All coefficients were found to be statistically significant beyond the .01 level (see Table 14, Appendix E).

Results of the Test of Validity

Multiple correlation coefficients were computed between the criterion variable of mean-grades and the predictor variables of the Wartegg total score and its parts. As shown in Tables 15 and 17, these coefficients are low which means that the present Wartegg scoring scale is unable to predict grades. The proportion of explained variance is 6.8 per cent, leaving a large percentage of unexplained variance that lowers the value of its predictive power. The multiple correlation coefficients between mean-grades and Wartegg total score is .26 as indicated in Table 17.

With the exception of Dimensionality, all simple correlation coefficients between mean-grades and the Wartegg total score and its sub-tests, which appear on Table 15, were found to be statistically significant at the .05 level. However, the interrelationship of all independent variables to the criterion are low. The Number of Objects sub-test score has the best predictive power with a .21 correlation coefficient, but even this relationship leaves an unexplained error variance of 95 per cent.

Additional information on the directional effect of the independent variables is provided by beta weights which appear in Table 19. Here again, Number of Objects and Integration have the best predictive relationship with the validating criteria with .17 and .18 beta weights. The predictive relationship of all other independent variables with mean-grades is insignificant.

As an additional test of validity, mean class grades were transformed to "z" values and these were then correlated. The transformation of the raw scores to "z" values did not affect the correlation coefficients. The results are identical to those of Table 15 (see Table 16, Appendix E).

CHAPTER V

SUMMARY, CONCLUSIONS, AND IMPLICATIONS FOR FURTHER RESEARCH

Summary

The Problem.--The main purpose of this research was to determine the usefulness of the Wartegg Drawing Completion Test as a predictor of academic achievement (mean-grades) among public school children in Guatemala, Central America. The sample was limited to second grade population in different geographical regions of that country.

The Wartegg total score and its parts constituted the independent variable. One of the hypotheses of this study dealt with the reliability of the DCT's scores; another with the validity of these to predict academic achievement; and two others were concerned with differences between the drawings in diverse areas of the country.

The Sample.--A stratified random sample of second grade students in rural, town or semi-rural, and urban public schools in different geographical regions of Guatemala was used. The total sample consisted of 283 second grade students from 16 randomly selected schools in four counties. There were 157 males and 126 females in this sample. A table of random numbers was used for school selection within each of the four counties.

Methodology.--The data was collected administering the Wartegg Drawing Completion Test to all second grade students, by classrooms, at the selected schools. The DCT was scored individually by means of a new scoring scale and its sub-tests were also scored. The validating criterion (mean mid-year grades in the main subjects) was obtained from the schools' official records.

The resulting data was arranged according to a code book (see Appendix D); punched on I.B.M. cards; and processed through the CORE programs at the Michigan State University Computer Laboratory. The results were tabulated, analyzed, and interpreted.

The Results.--Computation of reliability by the Analysis of variance method established that the total DCT score is well within the expected range of reliability (see Appendix F).

Intra-Test correlations, although positive and statistically significant, did not reach the expected levels. A multiple correlation coefficient of .57 was obtained between the Wartegg total and its parts. The independent variables, Number of Objects and Integration, contributed most to the total score. Three other independent variables contributed little to the total.

Score-rescore correlations between Wartegg total and its sub-test scores, for a partial subsample of 50, were all found to be statistically significant beyond the .01 level, the coefficient for the total score being .84.

The test of validity revealed that mean mid-year grades are not predicted by the total or partial Wartegg scores. A multiple correlation coefficient of .26 was found between grades and Wartegg total and its parts. A simple correlation coefficient of .12 was established between the criterion and the predictor. Simple correlations between other predictors (sub-test scores) and the criterion show little relationships which range from .11 for Dimensionality to .21 for Number of Objects. Partial correlation coefficients are also low which seems to confirm that the criterion (mean-grades) and the predictors (Wartegg total and part scores) do not reach the necessary relationship for predictive validity. The computed beta weights indicate that the sub-tests Number of Objects and Integration are the best predictors; but all, including these two, have very low predictive power.

Conclusions

1. The results of this study do not appear to support Hypothesis 1; i.e., that the total score of the DCT is predicted by the independent variables. Although correlations between the Wartegg total score and its sub-tests are all positive, and well beyond the one per cent level, they do not reach the established levels for the intra-test reliability.

2. Hypothesis 2 suggesting that the Wartegg Drawing Completion Test predicts academic achievement was not supported by the resulting low correlations between mean school grades and Wartegg total and part scores.

3. Analyses of variance of Wartegg total and partial scores of urban, town, and rural school children were found statistically significant. Urban children's DCT total and partial scores are higher than those of rural children. These results support Hypothesis 3.

4. Cultural differences, which affect the pupil's total and partial scores on the DCT, were also found to affect pupil's mean-grades among Guatemalan school population. Means and variances of both mean-grades and Wartegg total and partial scores differ to a greater extent between urban, town, and rural groups than within each of them. Analyses of variance also indicate that these differences are statistically significant between these samples. Since, as stated before, the "Spanish" culture predominates in the urban samples and the "Indian" culture predominates in the town and rural samples, these results seem to support Hypothesis 4.

Implications for Further Research

1. The findings reported here suggest that the reliability and validity of the DCT have to be improved if the test is to become a useful cross-cultural, non-language

measuring instrument to predict academic achievement among elementary school children. Therefore, the scoring scale should undergo further revisions and refinement. A gradual improvement of the scale could be obtained through computations of successive inter-scorer correlations after each new change in the scales is introduced.

2. A pilot study should be conducted to determine if the reliability of the test is improved if larger squares are used covering a considerably larger area of the sheet. Larger drawings would permit a better observation of test variables such as Proportionality, Dimensionality, and Meaningfulness.

3. The significant negative correlations between Integration and several other variables suggests that this variable does not measure the same psychological traits and could thus be excluded from the scoring scale.

4. Analyses of variance results indicate that mean class-grades differ significantly between classroom groups. If these variations had shown a high degree of correlation with the results on the Wartegg scores, it could have been inferred that these differences were due to actual differences in achievement levels of these groups. However, they do not coincide and thus seem to be due to the teachers' personal grading practices. Mean-class grades, therefore, cannot be considered to be a valid and reliable criterion to predict future academic achievement of pupils since

their future achievement grades would depend to a considerable extent on their future teachers' grading practices.

5. The best validation criterion to determine the validity of the Wartegg Test as a predictor of academic achievement would be pupils' success in passing grades. Use of such criterion would require a longitudinal study which would follow pupil progress until the end of their primary education.

6. Due to the design of this study, the age factor was not controlled. All second grade children, regardless of age, were included in the sample. Heterogeneity of ages probably obscured the interpretation of validity and reliability results, since raw scores on the Wartegg were correlated with the criterion variable.

7. Age norms for the Wartegg scores should be developed and these should be correlated with the criterion variable.

8. Further tests of reliability and validity of the Wartegg Test should be conducted incorporating some or all of the changes in research design, test form, and criterion variables suggested by the results of this study.

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APPENDICES

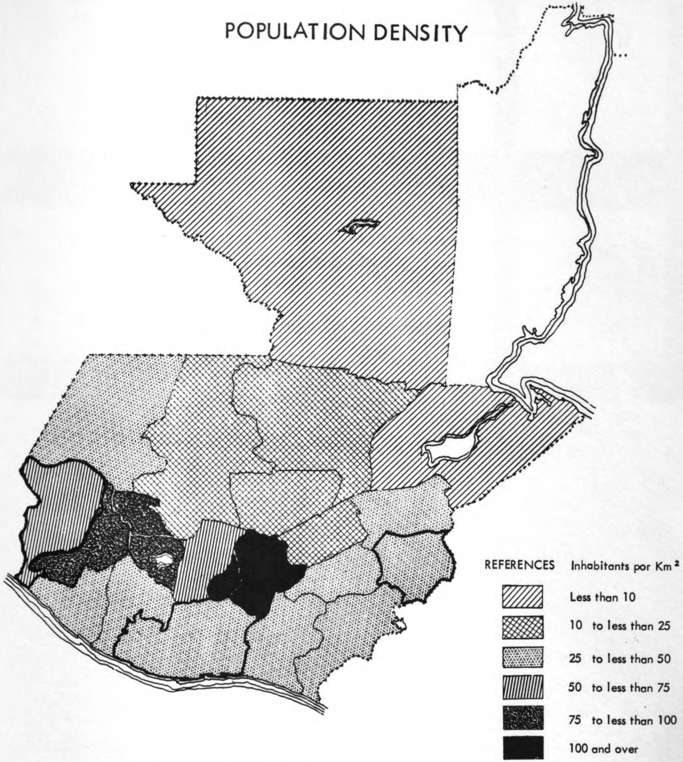
APPENDIX A

POPULATION DENSITY MAP

REPUBLIC OF GUATEMALA

REPUBLIC OF GUATEMALA

POPULATION DENSITY



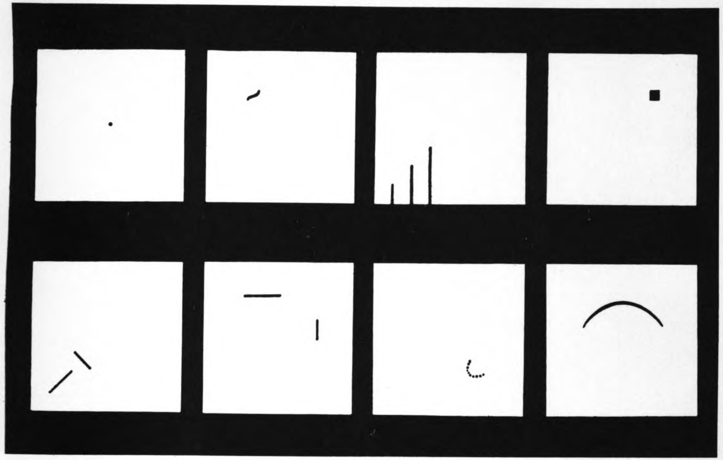
Population census of april 18, 1950
"Dirección General de Estadística Oficina permanente del Censo."

The counties included in this study are those marked with heavy borderlines.

APPENDIX B

WARTEGG DRAWING COMPLETION

TEST BLANK



WARTEGG DRAWING COMPLETION TEST

APPENDIX C

ACADEMIC ACHIEVEMENT PREDICTION SCALE

SCORING SYSTEM

DRAWING COMPLETION TEST						
AAPS						
3 Dimension Drawings	2 Dimension Drawings	1 Dimension Drawings	Integration	Meaningful Lines	Proportional	
Two or more 3-D objects in relationship to background detail.			+	+	+	60
			+	+	-	59
			+	-	-	58
			+	-	-	57
			-	+	+	56
			-	+	-	55
			-	-	-	54
			-	-	-	53
Two or more 3-D objects without background detail			+	+	+	52
			+	+	-	51
			+	-	-	50
			+	-	-	49
			-	+	+	48
			-	+	-	47
			-	-	-	46
			-	-	-	45
Single 3-D object with background detail.	Two or more 2-D objects in relationship to background detail		+	+	+	44
			+	+	-	43
			+	-	-	42
			+	-	-	41
			-	+	+	40
			-	+	-	39
			-	-	-	38
			-	-	-	37
Single 3-D object without background detail.	Two or more 2-D objects without background detail.		+	+	+	36
			+	+	-	35
			+	-	-	34
			+	-	-	33
			-	+	+	32
			-	+	-	31
			-	-	-	30
			-	-	-	29
	Single 2-D object with background detail.		+	+	+	28
			+	+	-	27
			+	-	-	26
			+	-	-	25
			-	+	+	24
			-	+	-	23
			-	-	-	22
			-	-	-	21
	Single 2-D object without background detail.		+	+	+	20
			+	+	-	19
			+	-	-	18
			+	-	-	17
			-	+	+	16
			-	+	-	15
			-	-	-	14
			-	-	-	13
SPECIAL CASES: 1. Two or more 2-D drawings which are simple stick drawings score no more than single 2-D drawings. 2. Minus 1 point for each repetitious theme drawn.		Duplication of or completion of stimuli in wholes--or lines.	+	+	+	12
			+	+	-	11
			+	-	-	10
			+	-	-	9
			-	+	+	8
			-	+	-	7
			-	-	-	6
			-	-	-	5
		Simple Scribbles	-	-	+	4
			-	-	-	3
		Motor Scribbles	+	-	-	2
		Wild Criss-Cross Lines	-	-	-	1
			-	-	-	0

ACADEMIC ACHIEVEMENT PREDICTION SCALE SCORING SYSTEM

APPENDIX D

CODE BOOK

CODE BOOK

The Development of the Drawing Completion Test as a Cross-Cultural Non-Language Measurement of Academic Achievement Among Elementary School Children.

John E. Jordan
Otto E. Gilbert

Instructions for the use of this CODE BOOK.

1. Code <u>0</u> or <u>00</u> will always mean <u>Not applicable</u> or <u>Nothing</u>.

2. Code <u>9</u> or <u>99</u> will always mean there was <u>No Information</u> or the <u>Respondent did not answer</u>.

3. Code <u>8</u> or <u>88</u> will always mean <u>Don't Know</u>, unless otherwise indicated.

4. In each case in the following pages the column to the left contains the column number of the IBM card; the second column contains the "variable" number used in the computer program; the third column contains an abbrivated form of the item; and the fourth column contains the code within each column of the IBM card with an explanation of the code.

5. Coder instructions always follow a line across the page and are clearly indicated.

6. In some cases when codes are equal to others already used, they are not repeated eacha time, but reference is made to a previous code or the immediately previous code with "same."

CARD 1

Column	Variable	Question Detail	Code
1, 2	1	Nation	01 - Hawaii 02 - Guatemala 03 - Japan 04 - 99 As assigned
3	2	Location (City)	1 - 9 As assigned 9 - No information
4	3	Region (Guatemala)	1 - Central 2 - West 3 - East 4 - South 9 - No information
5, 6	4	Group Number (Guatemala)	1 - J. Palma 2 - A. Marure "A" 3 - A. Marure "B" 4 - San Esteban 5 - El Ingeniero 6 - Sta. Elena 7 - Vado Hondo 8 - Jan Jacinto 9 - Sábana Grande 10 - Chamac 11 - Palo Gordo 12 - Champollap 13 - Federación 14 - Ixquihuila 15 - El Salto "A" 16 - El Salto "B"
7, 8, 9	5	Respondent Number	001 - 000 As assigned
10, 11	6	Deck or Card Number	01
12	7	Project Director	1 - Tanaka 2 - Gilbert 3 - Cessna 4 - 8 as assigned 9 - No information

Column	Variable	Question Detail	Code
13	8	Year of Administration	3 - 1963 4 - 1964 5 - 1965 6 - 1966 7 - 1967 8 - 1968 9 - 1969
14, 15	9	Month of Administration	01 - Jan. 02 - Feb. 03 - March 04 - April 05 - May 06 - June 07 - July 08 - August 09 - Sept. 10 - Oct. 11 - Nov. 12 - Dec.
16, 17	10	Day of Administration	01 - 31
18	11	Administered by	1 - Tanaka 2 - Gilbert 3 - Cessna 4 - 8 As assigned 9 - No information
19	12	Sex of Respondent	1 - Masculine 2 - Feminine
20, 21	13	Age of Respondent*	06 - 6 Years 07 - 7 years 08 - 8 years 09 - 9 years etc., i.e., years
22	14	Population of Stratified Area	1 - Rural (1 - 999) 2 - Town (1000-4999) 3 - City (5000-and over) 4 - 9 As assigned

*"Round" age to nearest year.

1-3

Column	Variable	Question Detail	Code
23,24,25	15	Grade Point Average** Guatemalan Sample (Range 0 - 100)	0 to 100 Record Actual Score
26,27,28	16	Drawing Completion Test Scores	000 - 480
29, 30	17	Total Number of Dimensions (DCT)	00 - 24
31, 32	18	Number of Objects (DCT)2	00 - 77
33,34	19	Number of Integrated (DCT)3 Drawings (Range 0.0 - 8.0)	00 - 80
35,36	20	Number of Meaningful (DCT)4 Drawings (Range 0.0 - 8.0)	00 - 80
37,38	21	Number of Proportional (DCT)5 Drawings (Range 0.0 - 8.0	00 - 80

**Instruction to Coder:

Col. 23, 24, 25 — Number grades from 0 to 100 are used. Record directly as given.

Col. 29, 30 (DCT) — The total number of dimensions in the eight (8) drawings constitute this total. Each drawing falls into one (1), two (2), or three (3) dimensional category. The sum of the dimensions constitutes the total score for these columns which can range from 0 to 24 (e.g., if the subject drew three (3) one-dimension drawings, two (2) two dimension drawings, and three (3) three-dimension drawings, his score would be 16.

Col. 21, 32 (DCT) — The total number of objects in the eight (8) drawings determines this range of 0 to 77. Two or more 2-D drawings which are simple stick drawings score as only one object. Abstractions and designs are not scored as objects.

Col. 33, 34 (DCT) — The total of eight (8) frames in which the stimulus has been integrated determines this score. Where partial or pseudo integration is the case, these are scored as halves (.5). Since parts must be considered, Column 33 will be used for wholes and Column 34 for parts, thus the range is from 0.0 to 8.0.

Col. 35, 36 (DCT) — Each frame is scored for meaningfulness. Meaningfulness is defined as the ability of the drawing to convey something of a representational nature to the examiner. Objects, designs, or other constructions which fit this definition for each frame and scored as one (1), thus the range is from 0 to 8.

Col. 37, 38 (DCT) — Total number of proportional drawings is determined by the scoring of one (1) point for every frame that the parts relate to the whole. Since proportionality depends upon meaningfulness, no drawing without this quality is perceived to be proportional. A range of 0 to 8 is used as each frame is scored independently.

APPENDIX E

DATA TABLES

TABLE 4.--One way analysis of variance of Wartegg total scores: geographical regions.

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	F
Between groups	58809.989	3	19603.330	20.453
Within groups	267404.018	279	958.437	
Total	326214.007	282		

TABLE 5 .--One way analysis of variance of Wartegg total scores: classrooms.

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	F
Between groups	132853.115	15	8856.874	12.230
Within groups	193360.892	267	724.198	
Total	326214.007	282		

TABLE 6 .--One way analysis of variance of Wartegg total scores: urban, town, and rural schools.

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	F
Between groups	48077	2	24038.5	24.20
Within groups	278135	280	993.0	
Total	326214	282		

TABLE 7 .--One way analysis of variance of mean-grades: geographical regions.

Source of Variance	Sum of Squares	d.f.	Mean Square	F
Between groups	10950.447	3	3650.149	11.502
Within groups	88536.302	279	317.334	
Total	99486.749	282		

TABLE 8 .--One way analysis of variance of mean-grades: classroom groups.

Source of Variance	Sum of Squares	d.f.	Mean Square	F
Between groups	23713.956	15	1580.930	5.571
Within groups	75772.793	267	283.793	
Total	99486.749	282		

TABLE 9 .--One way analysis of variance of mean-grades: urban, town, and rural schools.

Source of Variance	Sum of Squares	d.f.	Mean Square	F
Between groups	10224	2	5112	16.07
Within groups	89262	280	318	
Total	99486	282		

TABLE 10.--Simple correlations of the Wartegg total and its parts: total sample.

Variable	Wartegg Total Score	Dimensionality	Number of Objects	Integration	Meaningfulness	Proportionality
1. Wartegg Total Score	1.00°	.07	.44°	.32°	.27°	.27°
2. Dimensionality		1.00°	.12°	-.07	.14°	.14°
3. Number of Objects			1.00°	.05	.31°	.26°
4. Integration				1.00°	-.24°	-.10
5. Meaningfulness					1.00°	.83°
6. Proportionality						1.00°

N=283 °Significant at the .05 level.

TABLE 11.--Multiple correlation coefficients between Wartegg total and its parts: total sample.

R	R2	S	S2
.57	.32	27.98	782.64

N = 283

TABLE 12.--Highest order partial correlation coefficients between Wartegg total and independent variables including mean grades: total sample.

Variable	Partial Correlation Coefficient
1. Dimensionality	.03
2. Number of Objects	.37
3. Integration	.38
4. Meaningfulness	.14
5. Proportionality	.01

TABLE 13.--Beta weights of the Wartegg total and the independent variables: total sample.

	Variable	Beta Weights (N=283)
1.	Dimensionality	.02
2.	Number of objects	.34
3.	Integration	.36
4.	Meaningfulness	.22
5.	Proportionality	.02

TABLE 14.--Simple correlation coefficients between scores and re-scores of the Wartegg total test and its parts: sub-sample of total sample.

Variable	Simple Correlation Coefficients
1. Dimensionality	.66°
2. Number of Objects	.40°
3. Integration	.95°
4. Meaningfulness	.58°
5. Proportionality	.76°
6. Total	.84°

N = 50° Significant at the .01 level.

TABLE 15.--Simple correlation of mean-grades and Wartegg total and its parts: total sample.

Variable	Mean-grades	Wartegg Total Score	Dimensionality	No. of Objects	Integration	Meaningfulness	Proportionality
1. Mean grades	1.00°	.12°	.11	.21°	.14°	.15°	.16°
2. Wartegg total		1.00°	.07	.44°	.32°	.27°	.27°
3. Dimensionality			1.00°	.12°	-.07	.14°	.14°
4. No. of Objects				1.00°	.05	.31°	.26°
5. Integration					1.00	-.24°	-.10
6. Meaningfulness						1.00°	.83°
7. Proportionality							1.00°

N=283 °Significant at the .05 level.

TABLE 16.--Simple correlation coefficients between transformed mean-grades and Wartegg total and its parts: total sample.

Variable	Mean-Grades	Wartegg Total Score	Dimensionality	Number of Objects	Integration	Meaningfulness	Proportionality
1. Mean grades	1.00°	.12°	.11°	.21°	.14°	.15°	.16°
2. Wartegg total		1.00°	.07°	.44°	.32°	.27°	.27°
3. Dimensionality			1.00°	.12°	-.07°	.14°	.14°
4. No. of Objects				1.00°	.05°	.31°	.26°
5. Integration					1.00°	-.24°	-.10°
6. Meaningfulness						1.00°	.83°
7. Proportionality							1.00°

N = 283 °Significant at the .05 level.

TABLE 17.--Multiple correlation coefficients between mean-grades and Wartegg total and its parts: total sample.

R	R2	S	S2
.26	.0668	18.14	329.22

N=283

TABLE 18.--Highest order partial correlation coefficients between mean-grades and Wartegg total and its parts: total sample.

Variable	Partial Correlation Coefficients
1. Wartegg total score	-.05
2. Dimensionality	.09
3. Number of Objects	.15
4. Integration	.17
5. Meaningfulness	.06
6. Proportionality	.03

TABLE 19.--Beta weights of mean-grades and Wartegg total and its parts: total sample.

Variable	Beta Weights (N=283)
1. Wartegg total score	-.05
2. Dimensionality	.09
3. Number of Objects	.17
4. Integration	.18
5. Meaningfulness	.10
6. Proportionality	.05

TABLE 20.--Means and standard deviations of Wartegg total and its parts: total sample.

Variable	Mean	Standard Deviation
Total	163.55	34.01
Dimensions	15.52	6.12
Objects	8.88	3.10
Integration	5.28	2.70
Meaning	6.26	1.61
Proportion	5.73	1.59

TABLE 21.--Means and standard deviations of the Wartegg total scores: geographical regions.

Cases	Region	Mean	Standard Deviation	Deviation Overall Mean
85	Central	182.541	38.316	18.990
72	West	153.694	27.132	-9.857
68	East	166.338	30.969	2.787
58	South	144.690	21.987	-18.862
283	Total	163.551	34.012	---

TABLE 22.--Means and standard deviations of the Wartegg total scores: classroom groups.

Cases	Class	Mean	Standard Deviation	Deviation Overall Mean
25	J. Palma	199.320	34.764	35.769
31	A. Marure "A"	192.000	36.239	28.449
30	A. Marure "B"	157.367	31.021	- 6.184
16	San Estaban	148.562	19.218	-14.989
7	El Ingeniero	138.571	14.328	-24.980
14	Sta. Elena	137.500	19.334	-26.051
4	Vado Hondo	180.500	14.457	16.949
14	San Jacinto	183.143	32.394	19.592
13	Sabana Grande	146.154	11.817	17.397
18	Chamac	179.333	22.801	15.782
9	Palo Gordo	157.444	37.343	- 6.107
19	Champollap	186.368	26.506	22.817
16	Federación	149.125	24.135	-14.426
9	Ixquihuila	134.111	9.842	-29.440
28	El Salto "A"	142.607	14.114	-20.944
30	El Salto "B"	146.633	27.507	-16.918
283	Total	163.551	34.012	---

TABLE 23.--Means and standard deviations of the Wartegg total scores: urban, town, and rural schools.

Variable	Cases	Mean	Standard Deviation
Total	283	163.55	37.01
Urban	85	182.5	38.3
Town	95	150.5	28.6
Rural	103	159.9	27.6

TABLE 24.--Means and standard deviations of mean-grades: total sample and geographical regions.

Region	Cases	Mean	Standard Deviation
Central	85	69.41	18.24
West	72	62.29	16.70
East	68	58.73	15.28
South	58	52.16	20.99
Total	283	61.50	18.78

TABLE 25.--Means and standard deviations of mean-grades: classroom groups.

Cases	Class	Mean	Standard Deviation	Deviation Overall Mean
25	J. Palma	63.320	18.719	1.822
31	A. Marure "A"	76.452	17.646	14.953
30	A, Marure "B"	67.067	16.188	5.568
16	San Esteban	60.375	9.172	- 1.123
7	El Ingeniero	69.000	5.657	7.502
14	Sta Elena	61.286	20.185	- .212
4	Vado Hondo	79.000	24.304	17.502
14	San Jacinto	51.643	17.292	- 9.855
13	Sabana Grande	67.692	17.236	6.194
18	Chamac	65.333	13.074	3.835
9	Palo Gordo	63.667	13.592	2.168
19	Champollap	43.684	13.329	17.814
16	F3deración	60.500	9.026	- .998
9	Ixquihuila	71.222	8.121	9.724
28	El Salto "A"	52.428	20.513	- 9.069
30	El Salto "B"	51.900	21.778	- 9.598
283	Total	61.500	18.783	---

TABLE 26.--Means and standard deviations of mean-grades: urban, town, and rural schools.

Variable	Cases	Mean	Standard Deviation
Total	283	61.5	18.8
Urban	85	69.6	18.3
Town	95	54.5	20.0
Rural	103	61.4	15.2

APPENDIX F

COMPUTATION OF RELIABILITY BY ANALYSIS OF VARIANCE

COMPUTATION OF RELIABILITY BY ANALYSIS OF VARIANCE*

Arrange data in a matrix with each individual listed vertically and each item, subtest, or rater listed horizontally as in the following example:

Data

Individuals	Items						
	X_1	X_2	X_3	X_4	X_5	Sum	Sum^2
1	6	2	1	0	0	9	81
2	8	6	5	2	4	25	625
3	10	12	7	7	7	43	1849
4	5	11	11	9	8	44	1936
5	6	3	0	0	1	10	100
6	11	7	9	6	1	34	1156
7	7	7	2	5	5	26	676
8	4	7	4	4	1	20	400
9	6	3	3	2	4	18	324
10	6	5	1		1	16	256
Sum	69	63	43	38	32	245	7403
						245^2 = 60025	
(Sum^2)	519	495	307	224	174		
(Sum)^2	4761	3969	1849	1444	1024	13047	
						$\sum X^2$ = 1719	

R = number of rows (individuals)

C = number of colums (items, sub-tests, or raters)

X = score or rating of one individual from one item.

*based on Guilford, J. P. Psychonetic Methods. New York: McGraw-Hill, 1954.

Calculate analysis of variance as follows:

	df	Sum of Squares	Variance
Individuals (Rows)	R-1	$SS_R = \frac{\sum^{R}(\sum^{C} X)^2}{C} - \frac{(\sum\sum^{RC} X)^2}{RC}$	$S^2{}_R = SS_R/^{R-1}$
Raters (Columns	C-1	$SS_C = \frac{Z^{C}(\sum^{R} X)^2}{R} - \frac{(\sum\sum^{RC} X)^2}{RC}$	$S^2{}_C = SS_C/^{C-1}$
Error	(R-1)(C-1)	$SS_E = SS_T - SS_R - SS_C$	$S_E{}^2 = SS_E/(R-1)(C-1)$
Total	RC-1	$SS_T = {}^{RC}X^2 - \frac{(\sum\sum^{RC} X)^2}{RC}$	

<u>Analysis of Variance</u>

Individuals	9	$\frac{7403}{5} - \frac{60025}{5 \times 10} = 280.10$ (SS_R)	31.12 (S^2R)
Tests	4	$\frac{13047}{10} - \frac{60025}{5 \times 10} = 104.20$ (SS_C)	26.05 (S_C2)
Error	36	$518.50 - 280.10 - 104.20 = 134.20$ (SS_E)	3.73 (S_E2)
Total	49	$1719 - \frac{60025}{5 \times 10} = 518.50$ (SS_T)	

To find the reliability of the average ratings or the total score on the test

(1) $\sqrt{}_{tt} = \frac{S_R^2 - S_E^2}{S_R^2}$ Maximum likelyhood estimate of reliability

To find the average reliability of all the raters, items, or sub-tests when between-rater (between-item or between-sub-test) variance is to be removed. This is done when decisions are based on averages of complete sets of ratings from all

observers, or ratings which have been equated from rater to rater through use of ranks, z-scores, etc. Formula (1) may be obtained from formula (2) by application of the Spearman-Brown formula for the reliability of a test lengthened C times.

$$(2) \quad r_{tt} = \frac{SS_R - \frac{SS_E}{C-1}}{SS_R + SS_E}$$

To compute the average reliability of all the raters, items or sub-tests leaving in the between-raters (between-items, or between-sub-tests) variance. This should be done when decisions about pupils are based on a single score or rating which may be given by different sub-tests or different raters. Apply the Spearman-Brown formula to the reliability coefficient obtained from formula (3) to fine the reliability of the average of C raters, or sub-tests or items.

$$(3) \quad r_{tt} = \frac{SS_R - \frac{SS_C + SS_E}{C - 1}}{SS_R + (SS_C + SS_E)}$$

Examples of each formula:

(1) Reliability of average ratings or total scores $\frac{31.12 - 3.73}{31.12} = .880.$

(2) Average reliability of tests (or ratings) $\frac{31.12 - 3.73}{31.12 + (5-1)\ 3.73} = .595.$

$$(3) \quad r_{tt} = \frac{280.10 = \frac{(104.20 + 134.20)}{5 - 1}}{280.10 = (104.20 + 134.20)} = .4253$$

Using the general Spearman-Brown formula $r_{tt} = \frac{nr}{1 + (n-1)r}$

$$r_{tt} = \frac{(5.)(.4253)}{1 + (5 - 1)\ .4253} = .787.$$

n = number of times test is to be lengthened

r = reliability of short test