THE DEVELOPMENT OF THE DRAWING COMPLETION TEST AS A CROSS-CULTURAL NON-LANGUAGE MEASUREMENT OF ACADEMIC ACHIEVEMENT AMONG ELEMENTARY SCHOOL CHILDREN IN HAWAII

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THESIS

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IRWIN I. TANAKA

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John E. Gordon
Major professor

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ABSTRACT

THE DEVELOPMENT OF THE DRAWING COMPLETION TEST AS A CROSS-CULTURAL NON-LANGUAGE MEASUREMENT OF ACADEMIC ACHIEVEMENT AMONG ELEMENTARY SCHOOL CHILDREN IN HAWAII

by Irwin I. Tanaka

The Problem

Two recent studies with the Wartegg Drawing Completion Test have reported significant findings, and the authors have devised a scoring scale which has not been tested for reliability and validity.

This study has a dual purpose, to assess the reliability of the Wartegg Drawing Completion Test when scored by the Academic Achievement Prediction Scale (AAPS), and to assess the predictive validity of the test with selected criterion.

The Sample

The total sample of 792 subjects was obtained from nine schools which were randomly selected from all schools with kindergarten through grade six in the city and county of Honolulu. The 399 males and 393 females were randomly divided into two equal groups for replication and cross-validation purposes.

Methodology

The Wartegg Drawing Completion Test was administered to all subjects. Each test was then scored by the use of the Academic Achievement Prediction Scale by the author. Each tests was then rescored for individual variables scores; Dimensionality, number of Objects, Integration, Meaningfulness, and Proportionality.

Teacher rating and California Achievement Test Reading Scores were selected as validating criteria. Teachers ranked subjects according to the following scale: (1) Poor, (2) Below Average, (3) Average, (4) Above Average, and (5) Superior. The California Achievement Test (Reading Test only) was administered by the class teachers in April and all necessary data were collected by June, 1964.

The data were then properly coded and punched on I.B.M. cards following the code organized in the Code Book. Four CORE programs (multiple regressions) were computed at the Michigan State University Computer Laboratory.

Results and Conclusions

The major findings and conclusions of the study are:

1. The Academic Achievement Prediction Scale (AAPS) is a highly reliable scoring scale since the independent variables predicted the total score. Internal consistency of the scale was established by the close item correlations reported in the item analysis.

2. The independent variable of Dimensionality is the most discriminating variable since its high correlation with the criterion, analysis of partial correlation coefficients, and the beta weights indicate that this variable possesses the greatest predictive power.

3. The independent variable of Meaningfulness should be eliminated, since this item lacks discriminating power as evidenced by its insignificant correlation with the criterion. The removal of this variable will increase the reliability of the AAPS.

4. The present study indicates that the AAPS is not a valid predictor of academic achievement. Low multiple correlation coefficients were reported, and investigation of the independent variables reveals that these items did not predict the selected criterion.

5. The variable of Dimensionality most effectively predicts the other variables, including the total test score. The conclusion is that Dimensionality is the only valid predictor of academic achievement and this variable should be investigated in further research.

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CHAPTER I

INTRODUCTION

Nature of the Problem

Test development for all functions of measurement necessarily implies experimentation to achieve objectivity and precision in the instrument. A project of this magnitude requires the attempts of many researchers to achieve its goal. This particular study is a part of a larger undertaking in determining the usefulness of the Wartegg Drawing Completion Test as a cross-cultural, non-language measurement of academic achievement among elementary school children. Two studies in different geographic areas are simultaneously being conducted, Guatemala and Japan, and two others, Africa (24) and United States (36) have already been completed. The studies on Guatemala and Japan have identical designs to this present study; employing second grade children as the sample.

Projective techniques have come into wide use for cross-cultural studies. The non-language nature of the instrument makes it particularly applicable to differing cultures. With numerous failures being reported in the literature, cross-cultural studies in intelligence are held in suspect and many have concluded that "culture-free"

or "culture-fair" intelligence tests are impossible to construct. Cronbach (10:204) concludes that no universal test for measuring mental ability can be developed. Anastasi adds, "no test can be 'culture-free'. Since every test measures a sample of behavior, it will reflect any factor that influences behavior." (1:256) She is quick to add that "it is theoretically possible to construct a test that presupposes only experiences that are common to different cultures. Such a test would not be 'free' from cultural influences, but would utilize only elements common to many cultures". (1:256). Lindzey (32:191) reports that it remains a task for the future to demonstrate that they possess cross-cultural validity in use of projective techniques. Many other authors have concluded that a test can be fair for more than one culture only if the cultural values underlying the behavior to be tested are identical. The task of constructing such an instrument is still before us, thus this study will add to the long list of investigations of non-verbal drawing technique.

The Wartegg Drawing Completion Test was introduced to the United States in 1952 by Kinget as a projective technique for personality assessment. A prototype of this instrument was constructed by Sander at the University of Leipzig which resulted in the Phantasie Test (27:3). A colleague, Wartegg, constructed the present form of the

test based on Sander's work (49, 50,51). A research involving 383 "normal" adult subjects was reported by Kinget as her doctoral dissertation at the University of Louvain in Belgium.

An elaborate scoring device to aid in drawing interpretations was constructed by Kinget. Analysis of personality is scored on four components: emotion, imagination, intellect, and activity (27:9-10).

The Instrument

The Wartegg Drawing Completion Test (see page 64 in Appendix) consists of eight frames encased in a heavy black border. The first four frames are on the top row, and four more on the second row with a large blank area on the lower half of the test sheet. This test layout was designed by Kinget, and the blank area on the bottom half was designed primarily for purposes of noting descriptions by the clinician. For purposes of this study, the clinical notations were disregarded since no questions were asked of the subjects in interpreting their drawings. The stimuli are described as having the following properties by Kinget: (27:35-37).

> Stimulus 1, the dot, has the characteristic of smallness, lightness, roundness, centrality. In itself this stimulus is unimposing and could easily be overlooked by the less perceptive or less sensitive subject. However, its exact central position lends it an importance which retains the attention and calls for acknowledgement. Thus a tension arises between imagination and thinking, for the material

insignificance of this stimulus must be combined with its functional importance in order to result in adequate completion.

Stimulus 2, the wavy line, suggests somthing lively, mobile, loose, fluttering, growing, or flowing. The qualities of this stimulus decidedly resist matter of fact treatment or technical use and require integration into something organic or dynamic.

Stimulus 3, the three vertical regularly increasing lines, express the qualities of rigidity, austerity, regularity, order, and progression. These qualities may blend and produce complex impressions of dynamic organization, gradual development, methodical construction and similar concepts.

Stimulus 4, the black square, appear heavy, solid, massive, angular, and static and evokes concrete materiality. While stimulus 3, in spite of its mechanical character, still shows something growing and dynamic, stimulus 4 is completely inorganic and inert. It also has a somber appearance, conducive to associations or a somewhat depressive or, in rare cases, thretening character.

Stimulus 5, the two slanting lines, expresses predominantly the idea of conflict and dynamics. 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 construction or technical use.

Stimulus 6, the horizontal and vertical lines, has a strictly matter-of-fact sober, rigid, dull, and uninspiring aspect. At first sight it seems 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 ability.

Stimulus 7, the dotted half-circle, suggests something very fine, delicate, round, and supple that is at the same time appealing and a little puzzling because of its complex, beadlike structure. This structured 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 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 vasteness as proved by the frequent completion of this stimulus into natural phenomena such as rainbows or sunsets.

According to Kinget, further classification of stimuli can be made into two groups, organic (1, 2, 7, and 8) or to the technical-constructive quality of the remaining four stimuli. These groups can further be labeled feminine and masculine groups, meaning women prefer organic-emotional sphere and men the material-technical things (27:37).

Statement of the Problem

The precision and accuracy of an instrument must be determined before it becomes of any practical value. Foley has been extremely critical of the Wartegg Drawing Completion Test for "until such time as more objective scoring procedures are developed, and until the validity of the test has been more clearly established, it is virtually worthless as a measuring instrument" (14:669-70). The scoring scale adopted for this study was derived from previous studies with the Wartegg by Kinget (27), Keith (24), and Matheny (36). No reliability or validity studies have been reported as yet, thus this study will attempt to establish the reliability of the scoring scale that has been established from empirical data and intuitively by the previous

researchers. A further purpose is to determine the predictive validity of this instrument as a non-language, cross-cultural measure of academic achievement. Item analysis will be made on the independent variables that determine the scoring criterion to test the reliability and validity of the DCT, when utilizing the present scoring system (see Appendix for scoring system).

Justification for the Study

As previously mentioned, until the reliability and validity of an instrument has been established, measurements obtained from such tests are valueless. The present assessment of subjects is determined by the newly constructed scoring scale of Keith (24) and Matheny (36), thus determination of its ability to be consistent and to be able to make accurate predictions must be clearly established.

Although previous studies of cultural measurements have been unsuccessful, efforts have continued and Cattel's (8) work especially shows much promise. The merits of an instrument that would be a valid measure of cultural differences has clearly been established and would certainly have a ready market. Thus the search for an instrument for cross-cultural measurement continues. This study attempts to further this search by investigating different geographic locations and making a statistical analysis of

each area, as well as a comparative study of the Pacific, Far East, and Latin American regions.

The total research project will use samples from various geographic regions with a second grade population. The final analysis of data from the various geographic areas can lead to much broader generalizations. If significant results are obtained, the data can then be further studied for the possible standardization of norms for this age group. The potential value of this effort cannot be adequately evaluated at this time but the possibilities are exciting.

Limitations of the Study

For this particular study on Hawaii, the generalizations will be limited to the second grade population of public school children in the city and county of Honolulu. The stratified random sample was selected from this population, thus generalizations can legitimately be made only to this group. No effort will be made to go beyond the test of reliability of the scoring scale and the validity test against the selected criterion.

The Thesis in Perspective

Chapter 1, the introduction presents the overall objectives of this cross-cultural study with the Wartegg Drawing Completion Test. The statement of the problem, justification for the study, and the limitations placed upon this effort are included in this section.

Chapter 2, the literature is reviewed, one section devoted entirely to cross-cultural studies, and the final section specifically reviewing research reported on the Wartegg Drawing Completion Test.

Chapter 3, the method of sample selection, data collection, hypotheses to be tested, the scoring system, and test administration procedures are presented with the statistical analysis employed.

Chapter 4, analysis is made of the data with appropriate tables to aid in interpretation.

Chapter 5, a summary is made of the obtained results, and conclusions are reached. Recommendations are made for future studies.

CHAPTER II

A REVIEW OF THE LITERATURE

Anastasi (1:5) credits the interest in humane treatment of the feebleminded in initiating measuring instruments. This influenced Esquirol to publish two volumes in 1838 on the criteria for identifying and classifiying the feebleminded. Esquirol concluded that language usage was the most dependable criteria for intellectual level, thus this led to development of instruments which are based on language usage.

The use of drawings for the measurement of intellectual functioning followed in 1885, and was traced by Goodenough (16:2) to the work of Cooke who published an article on children's drawings. Other writers who contributed to the study were Perez, Sully, Barnes, Baldwin, Shinn, Brown, Clark, Herrick, Lukers, Maitland, O'Shea, and Goetze (16:3). These studies were marked by their lack of statistical treatment and descriptive nature.

The scientific study of children's drawings reached its height between 1900 and 1915. This period also found studies of international origin. Lamprecht (28:2) at the University of Leipzig gathered drawings from many cultures

but his work was never completed. Levinstein (30:2) summarized parts of the material, but no adequate study of this collection has ever appeared.

Ivanoff (21:4) studied drawings of Swiss children and offered a scoring system which includes: a sense of proportion, imaginative conception, and technical, and artistic value. Teacher ratings used for correlations proved positive for general ability and certain moral and social traits.

An investigation of "popular drawings" was undertaken by Katzaroff (22:4) and Maitland (34:4) in separate studies. The former found that "miscellaneous objects" were most frequently drawn, with houses second, and the human figure third by subjects in the six to 14 year range. Maitland's study indicated that until the age of ten, the most regularly occurring item drawn was that of the human figure. Burbury's (6:487-506) findings supported the conclusion that the spontaneous drawings of a house occur between the ages of five and eight.

The ability to represent the various segments of the body in a proportionate manner is seen by Schuter and Lobsien (16:4) to increase with advancement in chronological age.

In a two year study of drawings submitted by children in Munich and adjacent hamlets, Kerschensteiner (25:5) concluded that the drawings could be categorized in the following manner:

1. Purely schematic drawings.
2. Drawings made according to visual appearance.
3. A more mature attempt to give the illusion of a three-dimensional space.

Analysis was made noting the dissimilarities of normal and subnormal children's drawings. The normal child was found to exhibit more sophistication, while those of the subnormal group were noted to lack coherence. Also noted in male drawings were sex differences of their subjects.

Conversely, Goodenough (16:57), using her scoring system, maintained that while finding no significant quantitative differences between the sexes, a great deal of qualitative differences were apparent.

The spontaneous drawings of below-normal and younger normal children were studied by Rouma (40:7). The drawings were found to differ in the following aspects:

1. A definite tendency toward automatism.
2. Slow progression rate from one stage to another.
3. Frequent regression to previous levels of competence.
4. Numerous representations in the flight of ideas (thought).
5. Taken individually, certain drawings are very complete but careful analysis reveals a series of sketches evolved slowly, and with slight modifications.
6. Great anxiety shown in drawings.
7. Preference shown to those drawings which produce similar moments.
8. Meticulousness exhibited in work.

Marked differences were noted by Kik (26:9) in real creative ability and mere ability to copy. Pupils with genuine creative ability did superior school work as

compared to the inferior academic achievement by those who were classified as copyists.

Rouma (40:7) concluded that children with no previous art experience do not perform as well initially as compared to those with experience, but suggests that is equalized by a little practice.

Conclusions by Goodenough after a historical survey of children's drawings are:

1. In young children a close relationship is apparent between concept development as shown in drawing, and general intelligence.

2. Drawing, to the child, is primarily a language, a form of expression, rather than a means of creating beauty.

3. In the beginning the child draws what he knows, rather than what he sees. Later on he reaches a stage in which he attempts to draw objects as he sees them. The transition from the first stage to the second one is a gradual and continuous process.

4. The child exaggerates the size of items which seem interesting or important; other parts are minimized or omitted.

5. The order of development in drawing is remarkably constant, even among children of very different social antecedents.

6. The earliest drawings made by children consist almost entirely of what may be described as a graphic enumeration of items. Ideas of number, of the relative proportion of parts, and of spatial relationships are much later in developing.

7. In drawing objects placed before them, young children pay little or no attention to the model. Their drawings from the object are not likely to differ in any important respect from their memory drawings.

8. Drawings made by subnormal children resemble those of younger normal children in their lack of detail and in their defective sense of proportion.

They often show qualitative differences, however, especially as regards the relationship of the separate parts to each other. Not infrequently the same drawing will be found to combine very primitive with rather mature characteristics.

9. Children of inferior mental ability sometimes copy well, but they rarely do good original work in drawing. Conversely, the child who shows real creative ability in art is likely to rank high in general mental ability.

10. There is much disagreement among investigators regarding the relationship between children's drawings and those made by primitve or prehistoric races. Until more careful study has been made of legitimacy of drawing conclusions appears to be very doubtful.

11. Marked sex differences, usually in favor of the boys, are reported by several investigators, especially Kerschensteiner and Ivanoff.

12. Up to about the age of ten years children draw the human figure in preference to any other subject (16:12-13).

The Draw-a-Man Test was the result of Goodenough's studies which concluded that drawings would discriminate among levels of intelligence. This test, published in 1926, has undergone four revisions in its scoring system. Her present method divides the drawings into two broad classifications: Class A, unrecognizable scribbling not discernible as a human figure, and Class B, drawings representing a man in a scorable form. The factors of coherence, proportionality, detail, motor coordination, and full-faced or profile views of the man are taken into consideration in scoring. The test was standardized on a sample of 3,593 subjects.

The success of the Draw-a-Man Test can best be gauged by the multitude of research studies reported in the literature. As a cross-cultural tool, the Draw-a-Man Test has been extremely popular. Hunkin (20:52-63) tested 2,300 African children, and Hsiao (19) modified "a man with a short gown" for a Chinese study involving 4,000 children in Nanking. Working with a French population in Paris, Fay (16:22) devised a norm for ages seven to twelve. More explicit instructions were added by Winstock in 1935 and scoring was based upon the amount of accuracy of detail.

Machover (33) developed an instrument similar to Goodenough's, the Draw-a-Person Test. The subject is asked to draw a figure of a human being, then asked to repeat the process by drawing a figure of the opposite sex. A study to test Machover's body image hypothesis was conducted by Craddick (9) and his findings supported her hypothesis that a person projects his self image in his drawings. Wagner and Schubert (45) proposes an interesting scale, their administration requires two drawings, one of each sex, and they are rated in terms of a seven point scale.

The House-Tree-Person Projective Technique of Buck (5) was developed using drawings produced by mental patients at the University of Virginia Hospital. In a review by Harriman in Buros (7), three conclusions are

drawn: (1) the H-T-P technique cannot be properly mastered from the manuals, (2) this is one of the most thorough projective techniques of its type and it must be taken with utmost seriousness, and (3) there is need for more empirical data for this instrument. Brown's (2:173-184) review questioned the constancy of performance in drawings of this type. He was especially suspicious of the quantification of the results.

Luquet (40:8) studied the fluctuation of children's drawings and found that an appreciable time lapse is necessary before a drawing is fixed. The inconsistency of children's drawings led him to conclude that statistical treatment is not recommended.

A conflicting result reported in the study by Graham (17:385-386) suggests that human figure drawings offer a consistent picture of self-image; even where attempts are made to disguise.

In concluding the review of literature, mention should be made of ahother outgrowth of drawing techniques, projective assessment through finger painting as reported by Napoli (38:93-132). The paintings are interpreted by projective techniques.

Cross-Cultural Studies in the Pacific

Although the search for a "culture-free" test has met with much resistance, many attempts are presently

being made to find an instrument that would be "common" to many cultures. The work of Cattel (8) especially stands out in "culture-free" tests, and Leiter's (29) International Performance Scale has been administered to different ethnic groups in Hawaii.

Studies of cultural comparisons with drawing techniques have come into wide use with Goodenough's Draw-a-Man Test. Peterson and Telford (29) tested Negroes on St. Helena Island, Manuel and Highes (35) studies Mexicans and non-Mexicans, Dennis (11) with the Hopi Indians, Dennis (12) also administered the Draw-a-Man Test to near-Eastern school children, and Havinghurst et al. (18) studied six different Indian tribes, all with Goodenough's test. These examples show the interest that has been generated by the success of the Draw-a-Man Test. Studies with this instrument or similar ones are lacking in the Pacific area, and a careful review of the literature produces only one study in Indonesia with the Goodenough test. Thomas and Sjah (43) selected 1,245 children in grades one through six and administered the Draw-a-Man Test. The Indonesian subjects were compared against norms of American subjects and did not score as high. Teacher ratings were used and low correlations were found with the Goodenough scores, although all correlations were positive.

Walters (47) administered Thrustone's Primary Mental Abilities to Maori, natives of New Zealand, and white

children in three stratified areas in New Zealand and found significant statistical differences between the two groups. The cultural differences of the two groups present measurement problems which makes studies of this nature questionable.

Research With the Wartegg

Major criticisms of the Drawing Completion Test found in the reviews point to the lack of adequate statistical studies on the test. Foley (14) stated that there were no objective norms reported. "No objective method is described whereby the criterion status of each S was determined." He further argues that "until such time as more objective scoring procedures are developed, and clearly established, it is virtually worthless as a measuring instrument." The scoring system has been questioned by Gleser (15). Noted were three major omissions: (1) "no statistical data," (2) "author has made no attempt to provide any norms for the profile scores," (3) "and most important, no data are presented regarding the reliability of the external criteria used in developing the qualitative interpretations of the various scoring categories." Brown (3) sees the test having "heuristic and research potentialities," but that its immediate acceptance "is contradicted by its narrow and obsolete typological foundations." Kass (23) defends the Wartegg by "the ingenuity of its small graphic stimulus

elements, the brevity of its format, and the richness of the productions it elicits."

Baur (2) administered the Wartegg to 73 children, ages six to sixteen, and found distinctive drawing characteristics in each group. The children were all diagnosed as being enuretic, psychopathic, epileptic, mentally deficient, or suspected of schizophrenia.

Duhm (13) and Hemme Muller-Suur (37) analyzed drawings of over 2,000 subjects and found that the mentally retarded tended to (1) fail to integrate the starting design elements given on the test blank into their drawings, (2) show a marked repetition of simple graphic themes in their drawings, and (3) disregard the borders of the squares.

Stark (41) suggests that the Drawing Completion Test could be objectively scored as an intelligence test. A correlation of .790 between the Wartegg scores and the WISC scores lent support to this contention. A serious weakness of this study has been the development of a scoring system which has been subject to several revisions. Her scoring system was largely derived from variables suggested by Kinget but with a few additions gained from Goodenough's work. The following scoring factors were used by Stark: (1) orientation, (2) detail, (3) organization, (4) proportion, (5) dimension, (6) symbolism and/or abstraction, (8) movement, (9) originality, (10) variety, and (11) time.

Conclusions by Takela and Hakkarainen (42) based on a study of 1,025 subjects indicate that the Wartegg can be used to identify occupational groups and possibly predict vocational success.

Keith (24) presented his findings in an unpublished doctoral thesis which showed that the integration of stimuli in the drawings contributed significantly to a differentiation between the mean scores of high and low achieving children. Other variables in the study, repetition and disregarding the special divisions, did not produce differences in mean scores of his subjects; ninety-eight school-age children in Africa.

Another doctoral thesis by Matheny (36) compared the performance of fourth grade school children in the Lansing, Michigan district in the Drawing Completion Test, the Primary Mental Abilities Test (44), reading scores of the Stanford Achievement Test (45), and grade point averages. Significant correlations were found in all instances. The scoring variables which correlated significantly with the validating criteria were dimensionality, proportionality, and detail.

CHAPTER III

METHODOLOGY

The Sample

A total of nine schools was randomly selected out of all the public elementary schools in the city and county of Honolulu, Hawaii. All schools with kindergarten through grade six were included in this population. They were stratified into three levels, (1) urban schools in cities of 5,000 or more population, (2) towns or small city schools located in population centers of 1,000 to 4,999, and (3) rural schools in areas with less than 1,000 people. The selected school samples from the stratified areas are:

Urban
(1) Hokulani Elementary School
(2) Maemae Elementary School
(3) Likelike Elementary School

Town or Small City
(1) Aikahi Elementary School
(2) Alva Scott Elementary School
(3) Waimalu Elementary School

Rural
(1) Kaaawa Elementary School
(2) Laie Elementary School
(3) Maile Elementary School

In order to meet the necessary assumptions for interpretation, the following randomized procedure was followed:

1. Each school was assigned an identifying number.
2. A table of Random Numbers was run to select the schools in each stratified area.

Second grade students in each of the selected schools constitutes the total sample of 792 pupils. Including the total second grade population of every school satisfies the assumption of normality which is essential in making accurate statements about our sampled population. The large sample of 792 subjects should satisfy the assumptions of normal distributions. The Central Limit Theorem states that for a wide variety of populations, statistics based on large random samples are distributed normally (1:143). Use of this theorem justifies the assumption of normality and, thereby, increased the accuracy of predictions in this validity study. Further analysis of the descriptive data reveals an approximately equal distirbution of sexes in this sample, 393 males and 393 females. For purposes of this study, the sexes will not be dichotomized for the objectives are not to test differences in means of the two groups, or to make other comparative analysis of the two groups. Hereafter, the sample will be considered in total with combined sexes.

The public school system in Hawaii is rather unique in that there are no separate school districts, but only one state educational system under a superintendent. With a total of approximately 152,000 enrollments, more than 68,000 are in the elementary grades. Latest available

figures estimate the second grade enrollment to be around 13,696. The total population of the state is estimated at over 650,000, thus the school population constitutes about 28% of that total. Further investigations show that 61% of the pupils are in kindergarten and the primary grades with 36% in the secondary level.

A similar curriculum to that of most major school systems in the United States is offered in the elemntary and secondary levels. Special education programs, especially in the areas of the mentally retarded, guidance, and state minimum testing programs and services are available to the children of Hawaii's public schools.

Due to the limited geographic area of the city and county of Honolulu, stratifying into three separate population areas would serve no useful purpose. The furthest one can go from the heart of Honolulu to the most remote area would be approximately forty miles. The majority of the 650,000 people live on the island of Oahu, which is the center of all activities; social, economic, political, and cultural. Over 500,000 people inhabit the island, which is approximately forty miles long and thirty miles wide, and the entire area is under the political jurisdiction of the city and county of Honolulu. Therefore, there are no townships or villages that are incorporated on the island. Distances between designated towns are short and indeterminate, thus population estimates are very

unreliable. Add to this the ease of mobility and communication, differences in population would be non-existent. However, there are a few areas where cultural ties are still strong, and areas where there are predominate racial groups, but the effects of differences due to these factors have not been determined.

Data Collecting

The Wartegg Drawing Completion Test was administered in November and December, 1963, after clearances were granted by the superintendent, Mr. R. Burl Yarberry. Each second grade class was tested individually and teachers served as proctors to insure individual efforts.

Due to differences in grading practices, teachers were asked to rate each student according to the following ranking scale:

(1) Poor
(2) Below Average
(3) Average
(4) Above Average
(5) Superior

This procedure corresponds to most grading systems and is assumed to be as valid a measure as grade point averages.

The California Achievement Test, Form W, was administered to all second grade sections by their teachers as part of the state's minimum testing program. The reading portion of the total battery was the only test administered in April of 1964.

Cumulative record folders of the individual students selected for the sample furnished the necessary data on addresses, birthdates, ages, sex, birthplace, school, teacher, and date of entry for first and second grades. If the longitudinal study is continued as planned for the entire project, this information will be available, and locating the subjects for additional testing would be facilitated.

Research Hypotheses

To assess the reliability of the Academic Achievement Prediction Scale (AAPS) of the Wartegg Drawing Completion Test, item analysis will be made of the independent variables to the total score to see whether the parts predict the total by the following hypothesis:

1. The total score of the Wartegg Drawing Completion Test is predicted by the independent variables when scored by the AAPS.

Note: This research hypothesis does not employ the null hypothesis approach as a significance test. Measurement of reliability is not accomplished by a scaling procedure--each independent variable should predict the whole, so it predicts scoring if the multiple correlation is significant.

An analysis of the independent variables of the AAPS will be made through partial correlation coefficients. The hypotheses relative to the above are as follows:

2. Dimensionality does make a significant contribution to the total score.

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

4. The number of integrated stimuli makes a significant contribution to the total score.

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

6. The number of proportional drawings makes a significant contribution to the total score.

Note: Significant contribution is defined in this study as a statistically significant partial correlation coefficient. These coefficients will be analyzed to see their effect upon the prediction of the total score. Beta weights will also be considered in weighing the individual items to determine the variables which predict most effectively. This study will be replicated with a second sample from the same population.

To assess the validity of the AAPS, the total score and the independent variables will be correlated against the teacher's rating as the validating criterion. A multiple regression equation will be computed and analysis will be made of the independent parts. It is hypothesized that:

7. There will be a significant relationship between the Wartegg score with its independent part scores and teacher's ratings of individual students.

Note: A high multiple correlation coefficient will determine the validity of this instrument. A cross-validation technique will be employed, utilizing the variables with the best beta weights to increase the predictive ability of the instrument.

As a further assessment of validity, the total score with its part scores will be correlated against a second validating criterion measure, the California Achievement Test Reading Scores. Hypothesis for this validity study is:

8. There will be a significant relationship between the Wartegg score with its independent part scores and the reading scores of the California Achievement Test.

The Scoring System

The AAPS of the Drawing Completion Test is a product of Keith (24) and Matheny (36). Their system is based upon the work of Kinget (27) and the suggestions made by Stark (41). See page 66 of appendix B for the scoring system. The eight frames of the test are scored separately on a 0 to 60 point scale. Since a raw score of 60 can be obtained for each figure, the highest possible score for any individual would be 480.

Scoring Directions

The following instructions explain how the scoring is accomplished:

1. Determine whether the drawing is one, two, or three dimensional in nature.
2. Determine the number of objects in the 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 drawing is meaningful or has meaningful lines.
6. Determine for or against proportionality of drawing.

Example:

A single 2-d object without background detail.

1. Enter column 2, row 2.
2. If the object is integrated, scores would range from 17 to 20.

3. If the object is not integrated, socres would range from 13 to 16.

4. If the object was meaningful, possible scores would be 19 or 20, 19 if not proportional, 20 if it is proportional.

5. If the object is not meaningful, scores would be 17 or 18.

Special cases involve the use of additional scoring criteria which states: (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 following definitions of terms used in the scoring system are defined by Keith (24) and Matheny (36):

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. 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 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.

Test Administration

The following procedures and directions were practiced to insure uniformity:

1. Pupils were seated apart at safe distances to avoid cheating.

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

3. The subjects used number two pencils, each sharpened uniformily.

4. Instructions were given as suggested by Kinget as follows:

> 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 illustrates) (45:28-29).

In most instances, the instructions were repeated for purposes of clarity. Most of the pupils responded well, but a few needed additional instructions. Time for the test administration ranged from 30 to 55 minutes, averaging about 45 minutes.

Statistical Procedures

The sample of 792 subjects will be randomly assigned to two equal groups. As previously mentioned, no division will be made of the sexes for the purposes of this study of reliability and validity of the scoring scale. The first sample group of 396 subjects will be used for the reliability and validity study. The second group will comprise the sample for the replication of the reliability study and for the cross-validation technique in the validity test of the scoring scale.

A multiple regression equation will be computed following the CORE program of the Michigan State University Computer Laboratory. Essentially, five computations will be programmed to achieve the following:

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

2. Replication of the same program with the second sample.

3. Multiple regression equations with the teacher's rating 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.

4. Multiple regression equations with the CAT Reading Scores 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.

5. Multiple regression equations with the best validating criteria and the variables with the most significant beta weights as the cross-validation technique.

Validating Criteria

1. Teacher rating: Rating or ranking systems are inferior predictors. Variations in standards and in interpretation by teachers are reasons why it lacks predictive ability. Lindquist (31:87) suggests rank-in-class or other measures for more accurate predictions.

2. California Achievement Test, Form W, Reading Scores: The California Achievement Tests (45) are a series of comprehensive tests designed for the three-fold purpose of facilitating evaluation, educational measurement, and diagnosis.

The designers claim that the tests may be administered, scored and interpreted by following the approximate directions in this manual.

The reading test consists of two major divisions, vocabulary and comprehension. Reading vocabulary has four sections--word form, word recognition, meaning of opposites, and picture association. Reading comprehension covers two areas, following directions and interpretation of material.

Reliability coefficients for nine of the ten variables are given for grade two only. A reliability coefficient of .97 results when computed using Kuder-Richardson

Formula 21 on the six principal tests. The error of measurement is expressed in grade placement units rather than in raw score units.

Content and construct validity scores are reported in the manual. The test developers claim revisions through five editions, and items were selected after careful study. The tests were correlated against the Metropolitan Achievement and Stanford Achievement Tests. A small sample in each study minimizes the accuracy of the results.

CHAPTER IV

ANALYSIS OF THE DATA

Dividing the sample into two groups of 396 subjects each served a dual purpose: (1) testing the reliability of the scoring scale; (2) testing the validity of the instrument against a validating criteria. Each study in turn used the second group to: (a) replicate the reliability study; (b) provide cross-validation procedures for the validity test.

The total sample of 792 subjects was obtained from nine schools which were randomly selected from the total number of schools in the city and county of Honolulu. The subjects were then divided into two groups through the use of a table of random numbers.

The statistical data for analysis are found in Tables 1 through 17. The computations were obtained at the Michigan State University Computer Laboratory after key punching the necessary data on I.B.M. cards. A code book was organized for the expressed purpose of coding the data on the I.B.M. cards. (See Code Book in Appendix).

Results of the Test of Reliability; Hypotheses One Through Six

Thorndike (31:564) states that the evaluation of the reliability of any measure reduces to a determination of how much of the variation in the set of scores is due to systematic differences among the individuals in the group and how much to inaccuracies in measurement of the particular individuals. Application of the above statement to the results obtained from the multiple regression coefficient for Group One shows that 83.69 per cent of the variance in the total score can be explained by the variance of the independent part scores, leaving 16.31 per cent as error, or unexplained variance. The test of reliability is a test for the consistency of an instrument. Measurement and analysis of the results indicate that this is a highly reliable scoring device, as indicated in Table 3. A multiple correlation coefficient of .9148 was obtained for Group I, with a reported .8369 coefficient of multiple determination.

Examination of the partial correlation coefficients in Table 7 reveals interesting data. The independent variables of Dimensionality and number of Objects, make significant contributions to the total score but Meaningfulness, with a negative partial correlation, adds nothing to the total score. Possibly the variable, Meaningfulness, is incorrectly weighted with too much subjectivity on the

part of the scorer. Proportionality is another variable that adds little, thus its contribution to the total score is minimized.

Analysis of the simple correlations found in Table 5 also provide additional evidence that Dimensionality and number of Objects contribute significantly to the total Wartegg score. These are high correlation coefficients of .82 and .73, respectively, while the other three variables have correlations of .38, .43, and 405. Although all variables have correlation coefficients, the concern of this study is the degree of relationship of the independent variables to the total score.

A desirable procedure in reliability studies is to replicate the entire effort as a further measure of its consistency. This reliability test was replicated with a second sample of 396 subjects, selected by a table of random numbers from the total sample. The results were remarkably similar. Table 1 lists the means and standard deviations of the Wartegg score and all the independent variables scores for Group I. Table 2 lists the same data for Group II, while the combined or pooled data of the two groups are reported in Table 3. The Wartegg mean score for group I was 150.80, with a corresponding mean score of 149.79 for the second group. The mean score of the combined groups was 150.30. The standard deviations of the total score and all the part scores were also almost identical between Groups I and II (Table 3).

The second sample gave further evidence of reliability. The multiple correlation coefficient of .9250 was slightly higher than the .9148 indicated for the first group, as reported in Table 7.

In addition to partial correlation coefficients, beta weights were computed for each of the part scores on the total score. The beta weight, which is a one-way predictor, rather than a measure of co-relationship, states the predictive relationship more precisely than the partial correlation coefficient. Table 9 lists the beta weights of the variables, and analysis of the results indicate that Dimensionality and number of Objects are the best predictors of the Wartegg total score. Less accuracy in prediction is made by the variables Integration and Proportionality, and Meaningfulness. Comparing beta weights of the two groups, every independent variable shows similar results.

In conclusion, the test of reliability reveals that this instrument is highly consistent as a measuring device. The next section on the test of validity will attempt to determine whether the Wartegg total score and its independent variables predict to the selected criterion.

Table 1.--Means and standard deviations of the Wartegg total score and the independent variable scores: Group I.

Variable	Mean	Standard Deviation
1. Wartegg Total Score	150.01	41.58
2. Dimensionality Score	13.62	2.58
3. No. of Objects Score	8.40	3.21
4. Integration Score	7.03	2.19
5. Meaningfulness Score	7.58	.99
6. Proportionality Score	7.50	1.11

N = 396

Table 2.--Means and standard deviations of the Wartegg total score, and the independent variable scores: Group II.

Variable	Mean	Standard Deviation
1. Wartegg Total Score	149.79	38.34
2. Dimensionality Score	13.71	2.49
3. No. of Objects Score	8.38	2.36
4. Integration Score	6.97	2.35
5. Meaningfulness Score	7.56	1.02
6. Proportionality Score	7.44	1.19

N = 396

Table 3.--Pooled means and standard deviations of the Wartegg total score and the independent variable scores: Groups I and II.

Variable	Mean	Standard Deviation
1. Wartegg Total Score	150.30	39.96
2. Dimensionality Score	13.67	2.54
3. No. of Objects Score	8.39	2.79
4. Integration Score	7.00	2.28
5. Meaningfulness Score	7.57	1.01
6. Proportionality Score	7.47	1.15

N = 792

Table 4.--Means and standard deviations of the CAT reading scores, Wartegg total score, independent variable scores, and teacher ratings: Group I.

Variable	Mean	Standard Deviation
CAT Reading Score	56.03	21.77
Wartegg Total Score	150.81	41.58
Dimensionality Score	13.62	2.58
No. of Objects Score	8.40	3.21
Integration Score	7.03	2.19
Meaningfulness Score	7.58	.99
Proportionality Score	7.50	1.11
Teacher Ratings	3.02	.90

N = 396

Table 5.--Simple correlations of the Wartegg scores and the independent variables: Group I.

Variables	Wartegg Score	Dimensionality	No. of Objects	Integration	Meaningfulness	Proportionality
1. Wartegg Total Score	1.00	.82	.73	.38	.43	.41
2. Dimensionality		1.00	.54	.25	.50	.48
3. No. of Objects			1.00	.13	.36	.23
4. Integration				1.00	.09	.15
5. Meaningfulness					1.00	.92
6. Proportionality						1.00

N = 396

Table 6.--Simple correlations of the Wartegg scores and the independent variable: Group II.

Variables	Wartegg Score	Dimension-ality	No. of Objects	Integration	Meaningful-ness	Proportion-ality
1. Wartegg Total Score	1.00	.83	.72	.42	.50	.51
2. Dimensionality		1.00	.53	.17	.54	.52
3. No. of Objects			1.00	.22	.44	.43
4. Integration				1.00	.14	.23
5. Meaningfulness					1.00	.89
6. Proportionality						1.00

N = 396

Table 7.--Tabulated data of the multiple correlation coefficients between Wartegg scores and independent variables: Group I and II.

	R	R2	S	S2
Group I	.91	.84	16.90	285.55
Group II	.93	.86	14.66	214.86

Table 8.--Highest order partial correlation coefficient between Wartegg scores and each independent variable: Groups I and II.

Variable	Partial correlation coefficients	
	Group I	Group II
1. Dimensionality	.69	.78
2. No. of Objects	.65	.61
3. Integration	.39	.53
4. Meaningfulness	.21	.04
5. Proportionality	.23	.01

Table 9.--Beta weights of the Wartegg total scores and the independent variables: Groups I and II.

Variable	Beta weights	
	Group I (N=396)	Group II (N=396)
1. Dimensionality	.53	.61
2. No. of Objects	.46	.35
3. Integration	.18	.25
4. Meaningfulness	-.28	-.03
5. Proportionality	.29	.01

Results of the Test of Validity; Hypotheses Seven and Eight

The low multiple correlation coefficient reported between the criterion and predictor variables indicates that the scoring scale lacks a predicting relationship. (See Tables 10 and 11). With teacher rating as the criterion, the proportion of explained variance is 6.6 per cent, leaving a large percentage of unexplained variance that lowers the value of this instrument's predictive power. The precision of the instrument is increased slightly when the California Achievement Test Reading Score is used as the criterion, with 10 per cent of the variance attributed to the CAT Reading Score, but still the accuracy of the prediction is not satisfied. The multiple correlation coefficients reported are .26 for the teacher rating criterion and .32 for the California Achievement Test Reading Scores, as reported in Tables 10 and 11.

Examination of the simple correlations between teacher ratings (criterion) and the independent variables (predictors) show that the mutual relationships of all independent variables to the criterion are very low. (See Table 12). The total Wartegg score with a .22 correlation has the best predictive power, but this relationship with an unexplained error variance of 95 per cent reduces considerably the validity of the DCT. With lower correlations

reported for the other independent variables, it is a fair statement to say that the DCT does not predict to the selected criterion.

Granted that teacher ratings are highly unreliable, another criterion, the California Achievement Test Reading Score, was computed to determine the predictive ability of the DCT. The obtained results further substantiated the first criterion measure, for the multiple correlation coefficient of .32 is lacking in predictive power. (Consult Table 11).

Simple correlations between California Achievement Test Reading Scores and the independent variables produced comparable results with the teacher rating criterion. (See Table 12). Low correlation coefficients were obtained for all predictor variables, thus indicating weaknesses on the predicted score (CAT Reading Score).

Analysis of the partial scores in Tables 14 and 16 reveals further evidence that the part scores (independent variables) lacks the desired relationships with the selected criteria (teacher rating and CAT Reading Score) for predictive validity. An interesting observation in Table 16 indicates that adding Wartegg total score to the part scores does not add to the prediction of the CAT Reading Score criterion.

The Beta weights reported in Tables 15 and 17 to examine the directional effect of the independent variables

upon the selected criteria both give added evidence that this instrument does not possess predictive validity. The Wartegg total score has the best predictive relationship in with the validating criteria, with .27 and .299 beta weights. Other independent variables all give insignificant predicting relationships with the criteria.

As previously stated, significance levels were not reported by the writer although checks were made using the t-test of significance with the proper degrees of freedom, for the study concerned itself primarily with the strength of relationships between the criterion and predictor variables. In studies of this nature, although statistically significant results are obtained, interest is focused upon the ability of the instrument to measure with precision.

The proposed cross-validation attempt was discontinued due to the evidence obtained in the validation study.

Table 10.--Multiple correlation coefficients between teacher ratings and the independent variables: Group I.

R	R2	S	S2
.26	.0663	.87	.765

N = 396

Table 11.--Multiple correlation coefficients between California Achievement Test reading scores and the independent variable: Group I

R	R2	S	S2
.32	.100	20.8	432.64

N = 396

Table 12.--Simple correlations of teacher ratings and the independent variables: Group I

Variable	Teacher Ratings	Wartegg total Score	Dimension-ality	No. of Objects	Integra-tion	Meaning-fulness	Proportion-ality
1. Teacher ratings	1.00	.22	.15	.13	.15	.17	.18
2. Wartegg total score		1.00	.82	.73	.38	.44	.41
3. Dimensionality			1.00	.54	.25	.50	.48
4. No. of Objects				1.00	.13	.36	.20
5. Integration					1.00	.09	.15
6. Meaningfulness						1.00	.93
7. Proportionality							1.00

N = 396

Table 13.--Simple correlations of CAT reading scores, the Wartegg total score, and independent variable scores: Group I.

Variable	CAT	Wartegg total Score	Dimensionality	No. of Objects	Integration	Meaningfulness	Proportionality
1. CAT	1.000	.296	.264	.166	.133	.187	.205
2. Wartegg total score		1.000	.822	.733	.383	.438	.406
3. Dimensionality			1.000	.545	.245	.502	.480
4. No. of Objects				1.000	.129	.355	.204
5. Integration					1.000	.091	.145
6. Meaningfulness						1.000	.929
7. Proportionality							1.000

N = 396

Table 14.--Highest order partial correlation coefficient between teacher ratings and independent variables: Group I.

Variable	Partial correlation coefficients
1. Wartegg total score	.11
2. Dimensionality	-.07
3. No. of Objects	-.02
4. Integration	.06
5. Meaningfulness	.02
6. Proportionality	.02

N = 396

Table 15.--Beta weights between teacher ratings and independent variables: Group I.

Variable	Beta Weights
1. Wartegg total score	.27
2. Dimensionality	-.125
3. No. of Objects	-.037
4. Integration	.065
5. Meaningfulness	.058
6. Proportionality	.07

N = 396

Table 16.--Highest order partial correlation coefficient between California Achievement Test reading scores and independent variables: Group I.

Variable	Partial correlation coefficient
1. Dimensionality	.008
2. No. of Objects	-.04
3. Integration	.006
4. Meaningfulness	.02
5. Proportionality	.05
6. Wartegg total score	.13

N = 396

Table 17.--Beta weights between California Achievement Test reading scores and independent variables: Group I.

Variable	Beta Weights
1. Dimensionality	.015
2. No. of Objects	-.067
3. Integration	.007
4. Meaningfulness	-.078
5. Proportionality	.161
6. Wartegg total score	.299

N = 396

CHAPTER V

SUMMARY, CONCLUSIONS, AND IMPLICATIONS FOR FURTHER RESEARCH

Summary

The Problem.--The purpose of this study was to test the reliability of the scoring scale that has been devised by Keith (24) and Matheny (36) in previous studies. The reliability of this scoring scale has not been reported in the literature and other known Wartegg Drawing Completion Test studies have neglected to test for reliability. A further purpose was to determine the predictive validity of this instrument. Most of the reviews on the Wartegg were critical of this instrument because of the lack of reliability and validating data.

The Sample.--The total sample consisted of 792 second grade students from nine randomly selected public elementary schools from the city and county of Honolulu. There were 399 males and 393 females in this group. The total was then divided into two equal groups of 396 each, for replication purposes to test reliability and for purposes of cross-validation in the test of validity. A table of random numbers was used for school selection as well as subject selection for the two groups.

Methodology.--The Wartegg Drawing Completion Test was administered to all second grade students by individual classes at the selected schools. The DCT was scored individually, and for analysis purposes, independent variables were also scored for item analysis. Since different grading practices are followed in the selected schools, teachers ranked subjects according to the following rating scale: (1) Poor, (2) Below Average, (3) Average, (4) Above Average, and (5) Superior. It was assumed that this system of rating by teachers corresponds to a measure of grade point averages. Another selected criterion, the California Achievement Test Reading Score, provided additional data for analysis.

The resulting data were carefully arranged, following the code that was organized into a special code book. (See Code Book in Appendix). After all desired data were key punched on I.B.M. cards, the four CORE programs (multiple regressions) were computed at the Michigan State University Computer Laboratory. The results were analyzed and appropriate data were organized into tables for purposes of reporting and analysis.

The Results.--The test of reliability, or the test of consistency, revealed that the DCT is a highly reliable scoring device. A multiple correlation coefficient of .91 was obtained from one group, and when this procedure was

replicated upon a second group, a higher multiple correlation coefficient indicated that the independent variables, Dimensionality and number of Objects, made the most contributions to the total score, in all, five independent variables were investigated by item analysis.

Analysis of simple correlations were made and these analyses provided additional evidence that the independent variables, Dimensionality and number of Objects, contributed significantly to the Wartegg total score.

Replication of the entire reliability test with a second sample from the same population produced remarkably similar results. The Wartegg total mean score and standard deviations were almost identical in comparing the two groups. The higher reported multiple correlation coefficient (.925) gave further evidence of the reliability of the scoring scale. Examination of partials and beta weights revealed equally similar results of the two groups.

The results for the test of validity showed that the selected criterion was not predicted from the Wartegg total score and the independent variables. Two validating criteria were selected, a teacher rating and the California Achievement Test Reading Score. Both obtained results indicating the lack of this scoring scale to predict with necessary precision. Low correlation coefficients were obtained from the two studies, .26 for teacher rating as the validating criteria, and .32 for the California Achievement Test Reading Scores.

Examination of simple correlations showed weak relationships between the criterion and the predictors, with the Wartegg total score as the most precise predictor with a .22 correlation coefficient. These low reported correlations reduced considerably the predictive power of this instrument. Analysis of the partial correlation coefficients gave additional evidence that the criteria and part scores lacked the necessary relationship for predictive validity. Addition of the Wartegg total score did not increase the prediction of the criterion.

The reported beta weights, which is a directional predictor, indicated that the total score rather than its part scores had the best predictive ability, but all part scores showed insignificant predictive power.

Conclusions

1. The Academic Achievement Prediction Scale (AAPS) of the Wartegg Drawing Completion Test is a highly reliable scoring scale for the independent variables, or the individual parts, predicted the total score, which is the criterion. This is a test of internal consistency, determined by the items correlating with the total test score. Results by item analysis revealed that the items were discriminating for all items correlated significantly with the total test score.

2. The independent variable Dimensionality is the most discriminating item for its relationship with the

criterion is highly significant, and examination of the partial correlations and beta weights reveal that this variable has the best predictive power to the total score.

3. The independent variable Meaningfulness should be eliminated for this item does not discriminate, and the predictive ability of the instrument can be improved with the removal of this variable. In test construction, this procedure is highly recommended for non-discriminating items do not add to the reliability of the instrument, thus its removal would increase its reliability. The author suspects that there is too much subjectivity on part of the scorer to adequately score for meaningfulness. Some studies report findings that intelligent youngsters draw in abstractions. These non-meaningful drawings are most often misinterpreted, thus causing for unreliability in scoring this item. The definition itself is confusing, therefore elimination of this variable is indicated.

4. The Academic Achievement Prediction Scale (AAPS) of the Wartegg Drawing Completion Test is not a valid test of academic achievement. Investigation of the independent variables reveals that the variables do not predict to the selected criterion. Low multiple correlation coefficients for the two selected criteria do not support the hypothesis that achievement can be predicted from the Wartegg total score.

5. The independent variable of Dimensionality has the most precision in prediction. Adding the other four variables and the Wartegg total score to Dimensionality does not increase the prediction of academic achievement. Equally valid results are obtained by the elimination of the other variables, including the Wartegg total score. Proportionality correlates significantly with the criterion but when Dimensionality is partialed out, nothing is added to the prediction; therefore, Dimensionality is the only variable that is valid in the prediction of academic achievement.

Implications for Further Research

1. The findings reported in this study are limited to the population from which the sample was selected. The primary objective of the total project is to determine the usefulness of the Wartegg Drawing Completion Test as a cross-cultural, non-language measurement of academic achievement among elementary school children, thus reliability and validity studies following the design of this study should be replicated on other populations in selected geographic areas.

2. The scoring of this test was limited to one person, and the analysis has been accomplished with this limitation, thus no scorer reliability has been established. A team of scorers can re-score these test samples and computations can be made again with the new data.

3. It is further recommended that the total test battery of the California Achievement Test or another reliable achievement test (Stanford of metropolitan Achievement Test) be used as the validating criterion. This study had limitations due to the use of only reading scores from the California Achievement Test.

4. Since letter or numerical grades are not regularly given in Hawaii to second graders the teachers ratings may be invalid. A study should be conducted in a situation where grades are assigned by accustomed methods since grades are the criterion variable of the study.

5. Another recommendation is that this study be replicated upon another age group, preferably in upper elementary, as more reliable validating criteria are available for this population. Grade point averages are more firmly established and pupils' performance will have been observed adequately by the fourth, fifth, or sixth grades.

6. Additional studies can be continued with the demographic indices available from the present sample. No attempts were made in this study to analyze this data. Therefore, a study can be designed to measure for possible differences between age, sex, or stratified population areas.

7. Since the variable of Dimensionality was the only one of five variables that correlated significantly with the criterion, further investigation with this variable may produce results with more predictive power than obtained by this study.

REFERENCES

1. Anastasi, Anne. Psychological Testing. 2nd Ed. New York: MacMillan Co., 1926.

2. Baur, L. "Experiences with the Wartegg Test in our Children's Clinic," Nervenarzt, XXIII (1952), 52-55.

3. Brown, F. "A Review of the Drawing Completive Test," Journal of Proj. Tech., XVII (1953), 367-368.

4. Brown, F. "House-Tree-Person and Human Figure Drawings," as cited in D. Brower and L. E. Abt, eds., "Progress in Clinical Psychology," Journal of Clinical Psychology, XXV (1952), 173-184.

5. Buck, J. N. "The H-T-P, a Projective Device," American Journal of Mental Deficiency, LI (1947), 606-610.

6. Burbury, W. Mary. "The Use of Children's Drawings in Clinical Diagnosis," Journal of Mental Science, CIII (1957), 487-506.

7. Buros, O. K. (ed.) The Fifth Mental Measurements Yearbook. Highland Park, New Jersey: The Gryphon Press, 1959.

8. Cattel, R. B. "A Culture Free Intelligence Test: I." Journal of Educ. Psychol., XXXI (1940), 161-180.

9. Craddick, R. A. "The Self-Image in the Draw-a-Person Test and Self-Portrait Drawings," Jour. of Proj. Techniques and Personality Assessment, XXVII (Sept., 1963), 288-291.

10. Cronbach, L. J. Essentials of Psychological Testing. New York: Appleton-Century-Crofts, Inc., 1961.

11. Dennis, W. "Performance of Near-Eastern Children on the Draw-a-Man Test," Child Dev., XXVIII (1957), 427-430.

12. Dennis W. "The Performance of Hopi Children on the Goodenough Draw-a-Man Test," Jour. Comp. Psychol., XXXIV (1942), 341-348.

13. Duhm, Erna. "The Meaning of the Stanting Sign in the Wartegg Drawing Test," Psychol. Rdsch., III, No. 195, 242-248, revised in Psy. Abstracts, XXVII, No. 5867.

14. Foley, J. P., Jr. "The Drawing Completion Test," Amer. Journal of Psychol., LXVI (October, 1953), 669-670.

15. Gleser, Goldine C. "The Drawing Completion Test," Journ. of Ed. Psychol., XLIV (April, 1953), 251-253.

16. Goodenough, Florence. Measurement of Intelligence by Drawings. Chicago, Ill.: World Book, Co., 1926.

17. Graham, S. "A Study of Reliability in Human Figure Drawings," Journal of Projective Techniques, XX (1956), 385-386.

18. Havinghurst, R. J., Gunther, M. K., and Pratt, I. E. "Environment and the Draw-a-Man Test: the Performance of Indian Children," Jour. Abnor. Soc. Psychol., XLI (1946), 50-63.

19. Hsiao, H. H. "A Revision of Goodenough's Draw-a-Man Test," Monogr. Psychol. Educ., IV, No. 1 (1939).

20. Hunkin, V. "Validation of the Goodenough Draw-a-Man Test for African Children," Journal of Sociological Research in Pretoria, I (1950), 52-63.

21. Ivanoff, E. "Recherches Experimentales sure le Dessin des Exoliers de la Suisse Romande: Correlation entre l'Aptitude au Dessin et les Antres Aptitudes," Archives de Psychologie, VI (1913), 363, as cited in Goodenough, Measurement of Intelligence by Drawings, p. 3.

22. Kartzaroff, M. S. "Qu'est ce que les Enfants Dessinent?" Archives de Psychologie, IX (1910), 125, as cited in Goodenough, Measurement of Intelligence by Drawings, p. 4.

23. Kass, W. "A Review of the Wartegg Drawing Completion Test," The Fifth Mental Measurements Yearbook, Oscar K. Buros, ed., Highland Park, New Jersey: Cryphon Press, 1959.

24. Keith, J. "Assessing Academic Achievement with Specific Variables of the Drawing Completion Test in Certain Sub-Sahiaran Tribal Groups," A Pilot Study. Unpublished Doctoral Thesis, Michigan State University, 1963.

25. Kerschensteiner, D. Die Entwickelung der Zeichnerischen Begabung. Gerber, Munich (1905), as cited by Goodenough, Measurement of Intelligence by Drawings, p. 7.

26. Kik, C. "Die Uebernormale Zeichenbegabung bei Kinder," Zeitschrift fuer angerwandte Psychologie, II (1909), 92-149, as cited by Goodenough, Measurement of Intelligence by Drawings, p. 9.

27. Kinget, G. M. The Drawing Completion Test: A Projective Technique for the Investigation of Personality. New York: Green and Stratton, Inc., 1952.

28. Lamprecht, K. "Les Dessin d'Enfants Comme Source Historique," Bulletin de l'Academie Royale de Belgique, Nos. 9-10, 457-469, as cited by Goodenough, Measurement of Intelligence by Drawings, p. 2.

29. Leiter, R. G. Part II of the manual for the 1948 Revision of the Leiter International Performance Scale. Psychol. Serv. Cent. Jour., II (1950), 258-263.

30. Levinstein, S. "Kinderzeichungen bis zum 14. Lebensjahre, mit Parallelen aus der Urgeschichte, Kulturgeschichte, und Voelkerkunde, Voightlaender." Leipzig, 1905, 169 pages, as cited in Goodenough, Measurement of Intelligence by Drawings, p. 2.

31. Lindquist, E. F. (ed.) Educational Measurement. Washington, D.C.: American Council in Education, 1961.

32. Lindzey, G. Projective Techniques and Cross-Cultural Research. New York: Appleton-Century-Crofts, Inc., 1961.

33. Machover, Karen. Personality Projection in the Drawing of the Human Figure: A Method of Personality Investigation. Springfield, Ill.: Thomas, 1949.

34. Maitland, Louise, "What Children Draw to Please Themselves," Inland Educator, I (1895), 87, as cited by Goodenough, Measurement of Intelligence by Drawings, p. 4.

35. Manuel, H. T. and Hughes, L. "The Intelligence and Drawing Ability of Young Mexican Children," Jour. Apple. Psychol., XVI (1942), 382-387.

36. Matheny, K. B. "An Assessment of the Usefulness of the Wartegg Drawing Completion Test as a Measurement of Intelligence Among Children," Unpublished Doctoral thesis, Michigan State University, 1963.

37. Muller-Suur, H. "Psychiatric Experiences with the Wartegg Drawing Test," Nervenarzt, XXIII (1952), 446-450.

38. Napoli, P. J. "Interpretive Aspects of Finger-painting," Jour. Psychol., XXIII (1947), 93-132.

39. Peterson, J. and Telford, C. "Results of Group and Individual Tests Applied to the Practically Pure-blooded Negro Children on St. Helena Island," Jour. Comp. Psychol., XI (1930), 115-144.

40. Rouma, G. Le Langage Graphique de l'Enfant. Misch et Thron, Paris, 1913, as cited in Goodenough, Measurement of Intelligence by Drawings, p. 5.

41. Stark, Rosemary. "A Comparison of Intelligence Test Scores on the Sechsler Intelligence Scale for Children, and the Wartegg Drawing Completion Test with School Achievement of Elementary School Children," Unpublished Doctoral thesis, University of Detroit, 1954.

42. Takela, Martti and Heikkarainen, Marjatta. "Factor Analysis and Vlidity of the Wartegg Drawing Test," Ann. Acad. Sci., Findl, LXXXI, No. 1, Ser. B. (1953), 95 pp. reviewed in Psy. Abstracts, XXVII, No. 4654.

43. Thomas, R. M. and Sjah, A. "Draw-a-Man Test in Indonesia," Jour. Ed. Psychol., LII (Oct., 1961), 232-235.

44. Thurstone, L. L. and Thurstone, Thelma G. SRA Primary Mental Abilities. Chicago: Science Research Assoc., 1948-56.

45. Tiegs, E. W. and Clark, W. W. California Test Bureau Manual, California Achievement Test, Form W, 1957 edition.

46. Wagner, Mazie Earl and Schuber, J. J. P. "Figure Drawing Norms, Reliability and Validity Indices for Normal and Late-Adolescents, II, Development of a Pictorial Scale of D-A-P Quality," Amer. Psychol., X (Aug., 1955), 321.

47. Walker, Helen M. and Lev, J. Statistical Inference. New York: Holt, Rinehart, and Winston, 1953.

48. Walters, R. H. "The Intelligence Test Performance of Maori Children: A Cross-Cultural Study," J. Abnormal Sociol. Psychol., LVII (1958), 106-114.

49. Wartegg, E. "Gefuehl Neve Psychologie," cited by Kinget, The Drawing Completion Test: A Projective Technique for the Investigation of Personality.

50. _____. "Gefuehl und Phantasibild," cited by Kinget, The Drawing Completion Test: A Projective Technique for the Investigation of Personality.

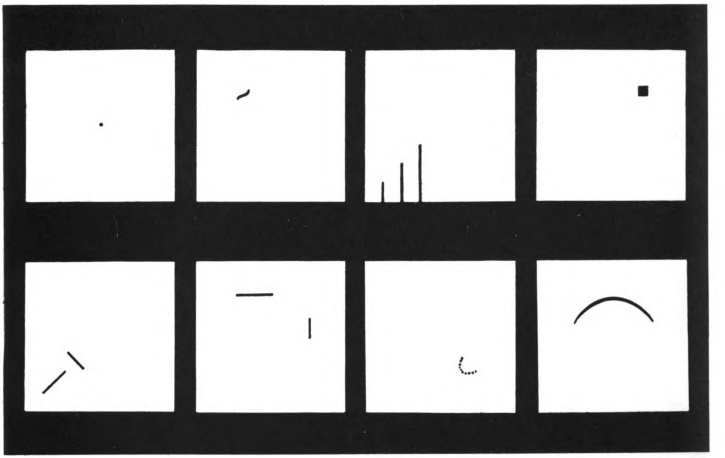
51. _____. "Gestaltung und Charakter," cited by Kinget, The Drawing Completion Test: A Projective Technique for the Investigation of Personality.

APPENDICES

APPENDIX A

WARTEGG DRAWING COMPLETION

TEST BLANK



Wartegg Drawing Completion Test Blank

APPENDIX B

ACADEMIC ACHIEVEMENT PREDICTION SCALE

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

APPENDIX C

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.

Instructions for the use of this CODE BOOK

1. Code 0 or 00 will always mean Not applicable or Nothing.
2. Code 9 or 99 will always mean there was No Information or the Respondent did not answer.
3. Code 8 or 88 will always mean Don't Know, 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 center column contains an abbreviated form of the item; the column to the right 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 each time, but reference is made to a previous code or the immediately previous code with "same."

CARD 1

Column	Question	Detail	Code
1, 2		Nation	01 - Hawaii 02 - Guatemala 03 - Japan 04 - 99 As assigned
3		Location (City)	1 - 9 As assigned
4		Region	1 - 9 As assigned
5, 6		Group Number (Hawaii)	01 - Alkahi School 02 - Hokulani School 03 - Kaawa School 04 - Laie School 05 - Likelike School 06 - Maemae School 07 - Maile School 08 - Scott School 09 - Waimalu School
7, 8, 9		Respondent Number	001 - 999 As assigned
10, 11		Deck or Card Number	01
12		Project Director	1 - 1 Tanaka 2 - 0 Gilbert 3 - W Cessna 4 - 8 As assigned 9 - No information
13		Year of Administration	3 - 1963 4 - 1964 5 - 1965 6 - 1966 7 - 1967 8 - 1968 9 - 1969
14, 15		Month of Administration	01 - Jan. 02 - Feb. 03 - March 04 - April 05 - May 06 - June

CARD 1

Column	Question	Detail	Code
14, 15		Month of Administration	07 - July 08 - Aug. 09 - Sept. 10 - Oct. 11 - Nov. 12 - Dec.
16, 17		Day of Administration	01 - 31
18		Administered by	1 - 1 Tanaka 2 - 0 Gilbert 3 - W Cessna 4 - 8 As assigned 9 - No information
19		Sex of Respondent	1 - Masculine 2 - Feminine 9 - No information
20, 21		Age of Respondent	06 - 6 years 07 - 7 years 08 - 8 years 09 - 9 years
22		Population of Stratified Area	1 - Rural (1 - 999) 2 - Town (1000-4999) 3 - City (5000 - and over) 4 - 9 As assigned
23, 24, 25		Grade Point Average* Hawaiian sample (Range 1.00 - 5.00)	100 - F 200 - D 300 - C 400 - B 500 - A
26, 27, 28		Drawing Completion Test Scores	000 - 480 999 - No response

*Instruction to coder:
Col. 23, 24, 25 Teacher ratings are to be used for Hawaiian sample in place of G.P.A. These ratings were derived by a scale which ranked subjects from (1) poor, (2) below average, (3) average, (4) above average, to (5) superior.

Column	Question	Detail	Code
29, 30		Total Number of Dimensions (DCT)	00 - 24
31, 32		Number of Objects $(DCT)_2$	00 -77
33, 34		Number of Integrated (DCT) drawings $_3$ (Range 0.0 - 8.0)	00 - 80
35, 36		Number of Meaningful (DCT) drawings $_4$ (Range 0.0 - 8.0)	00 - 80
37, 38		Number of Proportional (DCT) drawings (Range 0.0 - 8.0)	00 - 80
39, 40		California Achievement Test Reading Score totals	00 - 99

Col. 29, 30 $(DCT)_1$ The total number of dimensions in the eight (8) drawing constitute this total. Each drawing falls into a 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. 31, 32 $(DCT)_2$ 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 $(DCT)_3$ The total of eight 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.

Column	Question	Detail	Code
41, 42		C.A.T. Vocabulary	00 - 99
43, 44		C.A.T. Comprehension	00 - 99

Col. 35, 36 $(DCT)_4$ 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 are scored as one (1), thus the range is from 0 to 8.

Col. 37, 38 $(DCT)_5$ 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.