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ASSOCIATIVE LEARNING RATES OF SECOND, FOURTH, AND SIXTH GRADE BLACK AND WHITE STUDENTS WITH A SOCIOECONOMIC DIFFERENCE

A DISSERTATION

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degree of

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BY

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ASSOCIATIVE LEARNING RATES OF SECOND, FOURTH, AND SIXTH GRADE BLACK AND WHITE STUDENTS WITH A SOCIOECONOMIC DIFFERENCE

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Someone once said that "reading makes a full man, conference a ready man, and writing an exact man." In the progress on any one man's ventures all of these in one way or another serve to mold that man. Indeed, that is the case in this study.

My gratitude is extended fully to Dr. P. T. Teska, who has expressed a great deal of confidence in me and my capabilities. His direction has served me the opportunity to become a full man--a ready man--and an exact man.

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ASSOCIATIVE LEARNING RATES OF SECOND, FOURTH, AND SIXTH GRADE BLACK AND WHITE STUDENTS WITH A SOCIOECONOMIC DIFFERENCE

CHAPTER I

INTRODUCTION

Psychologists and educators have not arrived at a definite conclusion concerning the effect of environment on the learning rates of students. Jensen (1969) asserts that thus far research has been inadequate as a basis for definitive conclusions about the effects of racial differences on intelligence. He further believes that social deprivation has an effect on the average student and that attention needs to be focused on the higher-white-culture-influenced items which are included in intelligence tests.

Teachers of the disadvantaged have often remarked that many of these children seem much brighter than their IQ's would lead one to expect, and that, even though their scholastic performance is usually no better than that of middle-class children of similar IQ, the disadvantaged children usually appear much brighter in nonscholastic ways than do their middle-class counterparts in IQ (Jensen, 1968).

Attempts have been made to objectify this observation. Associative learning tests have been designed to measure learning ability independent of prior learning.

In light of this development, the rate and kind of learning of different socioeconomic groups merits reevaluation in the school setting.

The Problem

This researcher specifically designed and conducted an experimental study in paired-associate learning rates, using the *16-Picture Paired-Associate Learning Task* (PALT) to illustrate the effect of socioeconomic differences on the learning rate of students (*S*s) with normal intelligence. Data were collected to provide answers to the following question: Will normal IQ, lower-white and normal IQ, lower-black students learn the 16-Picture PALT with the same number of trials and/or errors as a group of normal-IQ, higher-white students?

The Purpose

The purpose of this study was to collect, analyze, and interpret data which would provide possible answers concerning the effect of socioeconomic differences, grade levels, and test administrators on the associative learning rates of *S*s of normal intelligence.

Review of Related Literature

In an attempt to establish the uniqueness of associative learning, it will be necessary to examine this concept as it has developed in the testing movement.

First Attempts to Measure IQ

Binet and his French co-workers devoted many years to active and ingenious ways of measuring intelligence. These ways of determining IQ ranged from palmistry to physiological measurements, and back again. As a result of these early efforts, Binet, in collaboration with Simon, prepared the first Binet-Simon Scale for measuring intelligence (Binet and Simon, 1905). In America a number of revisions of the Binet-Simon Scale were prepared, the most famous of which is the one developed under the direction of L.M. Terman at Stanford University, and known as the Stanford-Binet (Terman, 1916).

The Stanford-Binet in America

Since 1916, the original Stanford-Binet (S-B) scales have undergone several revisions which have been used in a variety of research projects. Most of these projects usually have been those requiring a more stringent IQ measure than can be obtained with group tests.

However, even though the S-B has established itself as the cornerstone for testing children's IQ in

America, it, along with other tests of "intelligence," has been criticized as being culturally biased in behalf of *S*s from the higher-white socioeconomic status (Voyat, 1969). Voyat (p. 75) asserts:

> IQ tests have been designed by whites for Western culture. Thus their value is limited to the culture within which they were designed. They can never be "culture-fair." Therefore, in any testing procedure of intelligence, relativity, not absolutism, should be the criterion, and even the correction of IQ tests for other populations is not valid. Furthermore, IQ tests are simply not adequate to measure processes of thinking. They provide results, they do not lead to an understanding of how intelligence functions.

However, Anastasi (1969) believed that to criticize tests because they reveal cultural influences is to miss the essential nature of tests. Anastasi (p. 558) summarizes her position as follows:

> Tests are designed to show what an individual can do at a given point in time. They cannot tell us why he performs as he does. To answer that question, we need to investigate his background, motivations, and other pertinent circumstances. Nor can tests tell how able a culturally disadvantaged child might have been if he had been reared in a more favorable environment. Moreover, tests cannot compensate for cultural deprivation by eliminating its effects from their scores. On the contrary, tests should reveal such effects, so that appropriate remedial steps can be taken.

For these reasons, and many others, it has been difficult to establish an adequate measure of the IQ for races other than white, or socioeconomic classes other than the middle and upper-middle.

Attempts to Measure the IQ of Different Races in America

One of the first, and by far the most extensive, attempts to measure the IQ of different races of people was a series of performance tests developed by Knox (1914) for testing foreign-speaking immigrants on arrival in the United States. In this experiment a series of tests were administered without the use of language. The main tests were the Ship Test and the Knox Cube Test. This marks the first attempt to do massive testing of other races.

Many other attempts to test the IQ of different races have followed. However, most of these attempts have encountered major difficulties. Lesser, Fifer, and Clark (1965) emphasized the complexity of the racial-testing problem when they studied four aspects of mental ability --verbal, reasoning, facility with numbers, and spatial concepts, in six- and seven-year-old children from both middle- and lower-class families drawn from four ethnic groups (Chinese, Jewish, Negro, and Puerto Rican). They took great care to create "culture-fair" tests and made an attempt to assure that children from all eight groups were motivated to perform at their best on the battery of mental tests. Lesser et al. (1965) found more similarity among middle-class children from the four ethnic groups than among lower-class children from the same ethnic groups. This similarity was present on each of the mental-ability tests. Apparently, membership in the middle class has some kind of an homogenizing effect. Because, the distinctive cultural features of different ethnic groups begin to fade as families move up the socioeconomic ladder (Krech, Crutchfield, & Livison, 1969). In regard to the four aspects of mental ability and different ethnic groups, Chinese children did best on reasoning and spatial abilities; Jewish children did best on verbal and numerical abilities; and Negro children did relatively best on verbal ability, and relatively poorest on numerical and spatial abilities. It is interesting to note the finding that social class is a more important influence on the performance of Negro children, on all four abilities, than on the performance of the other three groups. In other words middle-class Negro children showed a greater advantage over lower-class Negro children than was the case when the middle-versus-lower comparison was made for the other three groups. Such results raise more questions than they answer, but they do provide certain "proof" against glib generalizations. Social class, ethnic origin, racial factors--all apparently have something to do with intellectual functioning. In the study by Lesser et al. (1965), no attempt was made to define the groups biologically; "common sense" or social definitions were used. Their findings may be summarized as follows: Negro children, on the average, earn lower intelligence test scores than do white children.

One of the most carefully-controlled, early studies was that of Tanser (1939). In this study carefully chosen samples of 386 whites and 103 Negro pupils were tested with four different intelligence tests, both verbal and nonverbal. On all tests the average white child surpassed the average Negro child. For instance on the National Intelligence Test, the mean IQ was 103.6 for white children and 89.2 for Negroes. This difference held whether rural Negro and rural white children or urban Negro and urban white children were compared.

Socioeconomic Status (SES) and IQ

In studies comparing Negroes and whites, even when social class is controlled, Negroes as a group tend to score lower in tested intelligence (Dreger & Miller, 1960; Deutsch & Brown, 1964). Projects involving the comparison of whites and other minority groups generally indicate similar mean differences (Anastasi, 1958).

Coleman et al. (1966) found in an investigation involving first graders that children of lower SES and children from minority groups start school with mean scores on intelligence tests below the national white average.

Several studies (Bereiter, 1965; Gray & Klaus, 1965; Pasamanick & Knoblock, 1955; Bloom, 1964) have reported significant differences between students from higher SES and lower SES when intelligence tests are administered. These experiments also revealed increasing mean differences as the students increased in age.

Associative Learning

For the purpose of this study attention was focused on a particular dimension of learning ability-learning by association.

Associative learning is defined by Hall and Lindzey (1957, p. 540) as "the spatial and temporal linking of two events." This learning is usually accomplished by using paired associates material. This is material used in verbal learning, consisting of a list of pairs of items in which one serves as a "stimulus" and the other as "response." Paired-associate learning is learning to respond with a <u>second</u> item of a pair when the <u>first</u> item is presented.

Attempts to Measure the Associative Learning Rates of Different Minority Groups

A search of the literature revealed a paucity of experiments relating to paired-associate learning tasks as a means of discovering more about the learning rates of normal elementary school students with cultural differences. This is true even though psychology of learning seems to be one of the most important elements in the preparation of people for the profession of teaching. Also, much has been done in recent years to assist students who have cultural handicaps.

It should be noted, however, even though research in this area of paired-associate learning has not been abundant, informal writing and speaking relative to the topic have been plentiful. During recent years periodicals have devoted much space to the topic of culture-fair IQ tests and paired-associate learning. The discussion of paired-associate learning also fills considerable space in books pertaining to the psychology of learning.

In an attempt to provide a background of research for this investigation, several studies were selected for consideration. Since all of these were completed after 1958, support seems to be given to the point of view that genuine concern about paired-associate learning is of relatively recent origin.

In 1962, Hiner conducted an experiment with a 12-picture paired-associate learning task to compare the associative learning rates for bright, normal, and retarded children. Hiner based her conclusions and recommendations upon the information obtained by testing 90 students--30 bright, 30 normal, and 30 retarded. After completing the statistical analysis of the data collected from the paired-associate learning task, Hiner (p. 38) made the following report:

> The findings in this study reveal no significant difference in the rate of learning on a paired-associate learning task between retarded children and normal or bright children.

> They reveal no significant difference in the number of errors made by the retarded children and the number made by normal or bright children, in reaching the learning criteria for the paired-associate learning task employed in this study.

Hiner (p. 40) presented the following conclusions:

> Since these findings reveal no significant differences in learning rates and number of errors to reach the learning criterion, a more exploratory type of approach to the values and processes governing the learning situation should be observed by psychologists and educators.
>
> Something other than ability to learn was involved in the reading failures being suffered by the children observed in this particular situation.

Semler and Iscoe (1963) compared the performance of 134 Negro and 141 white children ranging in age from 5 through 9 years on a paired-associate learning task. The subjects were selected randomly and each child was administered a Wechsler Intelligence Scale. After approximately a week each child was administered a 6-picture paired-associate learning task. The purpose was to compare the abilities of Negro and white children on a paired-associate learning task where previous measurement had determined that the white children had significantly higher IQ's. Since the relationship between measured intellectual status and learning ability is not clearly understood (Sarason & Gladwin, 1958) and since paired-associate learning ability does not seem to be closely related to intelligence level (Berkson & Cantor, 1960; Eisman, 1958), Semler and Iscoe hypothesized no difference would be found between Negro and white children.

Although Semler and Iscoe found significant racial differences present on the Wechsler, they did not find significant differences in the paired-associate learning rates. Correlations between IQ and learning task scores were low for both groups (.09 for whites, .19 for Negroes).

In summarizing their study, Semler and Iscoe (p. 44) make the following comment:

> Our findings of no overall race differences in learning ability should not be minimized. We suggest that educators exercise great caution in inferring learning ability from measured intellectual level alone.

Rohwer (1966), Jensen (1961), and Rapier (1966) found that performance of lower- and middle-class Negroes; Mexican-Americans and Anglo-Americans; and lower- and middle-class Caucasians, respectively, does not differ markedly in paired-associate learning. These researchers found the relation between tested intelligence and performance on the learning tasks was high for the higher-status groups but negligible for the lower-status groups. Jensen (1968) asserts that these findings suggest the learning ability of children from lower-status backgrounds is not adequately reflected in general intelligence tests. He argues that research is needed to clarify the reasons for these unique relationships which seem to reflect that intelligence tests are "truer" estimates of ability for middle-class groups than for the lower-class groups.

In 1967, Welsh made a study in which he analyzed the associative learning rates of bright, normal, and retarded children using paired-associate lists of varying lengths. Welsh used 216 boys and girls with chronological ages ranging from 108 to 131 months in order to determine the effect of list length on the associative learning ability of bright, normal, and retarded children. Welsh (p. 56) summarized his findings as follows:

> On the 16-pair list, the Brights performed signigicantly superior to both Normals and Retardeds, while on the 20-pair list, the two higher intelligence groups performed significantly better than the Retarded Group. Furthermore, the performance differences among the groups increased from the 16-pair to the 20-pair list. As was hypothesized, no significant difference was found among the groups in the 12-pair list condition. An examination of the learning trends revealed that, while the Brights and Normals did not perform significantly different across the three list lengths, the Retardeds learned at a significantly slower pace in each of the two longer list length conditions. Since previous associative learning experiments had failed to recognize list length as a relevant variable, this finding places considerable doubt upon many of the conclusions resulting from the research done in this area.
>
> An analysis of experimenter and sex effects revealed that, in this particular study, these two effects did not produce significant subject differences.
>
> Although the mass data demonstrated highly signigicant differences in the direction of the experimental hypotheses, an achievement overlap among the three groups and the consistent wide variability of the Retardeds suggest the presence of unspecified factors influencing learning performance. It was proposed that teachers recognize that many variables other than inherent learning potential contribute to the retarded student's performance in any particular learning situation.

Purdy (1968) completed an experimental study on associative learning rates for second, fourth, and sixth grade Indian and white children using a paired-associate learning task. Purdy's findings were based upon the data secured while administering the paired-associate learning task to 216 boys and girls in the second, fourth, and sixth grades. Purdy (p. 50) reports the following:

> Inasmuch as the Indians at each grade level learned the task with fewer trials and fewer errors and the Indians at the sixth grade learned the task with statistically significantly fewer trials (to the .05 level of significance) than did the sixth-grade whites, these conclusions are evident: (1) that to the degree that intelligence is defined as the ability to learn, the sixth-grade Indians are innately more intelligent than are the sixth-grade whites in this sample, even though their IQ scores on the Otis _Quick-Scoring Mental Ability Test_ are the same; (2) that the sixth-grade Indians' deprived environmental background and their attitudes towards themselves and towards their ability to learn caused them to score no better on the _Otis Quick-Scoring Mental Ability Test_ than their white counterparts scored, even though their ability to learn the 16-picture paired-associate learning task in statistically significantly fewer trials than did their white counterparts gives evidence that the Indians are innately brighter. The evidence which leads to these conclusions leads to a third conclusion: that on the learning task used in this study, the Indians scored better (and the sixth-grade Indians scored statistically significantly better) than did their white counterparts in spite of the fact that the whites probably have more positive attitudes towards their ability to learn the task, whereas the Indians probably have more negative attitudes towards their ability to learn the task.
>
> Results from this study indicate a need for further research into differences which might exist between children from high socio-economic levels, where school is a means of maintaining a more desirable place in society, and children from deprived environments, where there is little interest in school.

In summarizing it should be noted that although most of the research studies reviewed in this chapter were concerned only incidentally with students deprived of characteristics enjoyed by higher white students, several of the studies have made significant contributions concerning this aspect of learning as experienced by elementary school students. The limited amount of research in this area to date makes it apparent there are numerous types of studies that might be conducted to insure continued improvement in the education of students who have been culturally deprived. This is especially true considering that a relatively large percentage of the total school population in the United States is placed in the category of having been deprived of social, economic, and status (SES) characteristics available to higher-white students (_S_s).

Operational Definitions

Learning. A relatively permanent change in behavior brought about by reinforced practice.

Associative Learning. The spatial and temporal linking of two events.

Paired-Associate Material. Material used in verbal learning, consisting of a list of pairs of items in which one item of the pair serves as a stimulus and the other as a "response."

Stimulus Item. The first of two items presented to a subject in paired-associates material.

Response Item. The second of two items presented to a subject (_S_) in paired-associate material.

Paired-Associate Learning. Learning to respond with a second item of a pair when the first item of paired-associate material is presented.

Normal Intelligence. A resultant intelligence quotient (IQ) within the 90-110 range as measured by the *Stanford-Binet Individual Intelligence Scale* (1960 revision; Form L-M).

Student Error. The result of the *S*'s failure to respond to a stimulus item within five seconds after presentation, *or* the response to a stimulus with the wrong "response" item.

Student Trial. The result of the cumulative presentation and evocation of responses for all 16 pairs of the *16-Picture Paired-Associate Learning Task* (PALT). If the *S* failed to correctly associate any or all of the pairs during the presentation of the 16 pairs, the result was considered *one* trial. (Note: several errors can occur during one trial.)

Trials to Criterion. The cumulative total of trials necessary for the *S* being tested to achieve two successive, correct repetitions of the 16-Picture PALT.

Errors to Criterion. The cumulative total of all errors recorded, for the *S* being tested, during the trial sequences needed to achieve two successive, correct repetitions of the 16-Picture PALT.

Socioeconomic Status (SES). That status of society determined by the Administration of the Oklahoma City

Public School System, the primary factor being the number of Title I students enrolled in schools in a given geographical area.

Title I Students. Those students whose parents or guardians fall in an economic category which enables the school they are attending to be paid extra funds for their education. Title I is a subsidiary component of the *Elementary and Secondary Education Act of 1965*.

Lower-White SES. The category assigned to *S*s coming from schools which have predominantly white enrollment and a relatively high proportion of Title I students.

Lower-Black SES. The category assigned to *S*s coming from schools which have a predominantly Black enrollment and a relatively high proportion of Title I students.

Higher-White SES. The category assigned to *S*s coming from schools which have a predominantly white enrollment and a relatively low proportion of Title I students. (The school chosen as Higher-White had no Title I students.)

Hypotheses Concerning Trials

The following hypotheses were tested concerning *Trials*:

H_1: There will be no significant difference in the number of trials needed by subjects (*S*s) from the three SESs in learning the 16-Picture PALT.

H_2: There will be no significant difference in the number of trials needed by Ss from the three grades in learning the 16-Picture PALT.

H_3: There will be no significant difference in the number of trials needed by Ss in learning a 16-Picture PALT when they are tested under different experimenters.

H_4: There will be no significant difference in the number of trials recorded for each group caused by the interaction of SES and grades (A x B).

H_5: There will be no significant difference in the number of trials recorded for each group caused by the interaction of SES and testers (A x C).

H_6: There will be no significant difference in the number of trials recorded for each group caused by the interaction of grades and testers (B x C).

H_7: There will be no significant difference in the number of trials recorded for each group caused by the interaction of SES, grades, and testers (A x B x C).

Hypotheses Concerning Errors

The following hypotheses were tested concerning Errors:

H_1: There will be no significant difference in the number of errors committed by subjects from the three SESs in learning the 16-Picture PALT.

H_2: There will be no significant difference in the number of errors committed by Ss from the three grades in learning the 16-Picture PALT.

H_3: There will be no significant difference in the number of errors committed by Ss in learning a 16-Picture PALT when they are tested under different experimenters.

H_4: There will be no significant difference in the number of errors recorded for each group caused by the interaction of SES and grades (A x B).

H_5: There will be no significant difference in the number of errors recorded for each group caused by the interaction of SES and testers (A x C).

H_6: There will be no significant difference in the number of errors recorded for each group caused by the interaction of grades and testers (B x C).

H_7: There will be no significant difference in the number of errors recorded for each group caused by the interaction of SES, grades, and testers (A x B x C).

Major Assumptions

For the purpose of this study, the following assumptions were made:

1. Associative learning is a legitimate area of study.
2. Associative learning can be isolated and measured.
3. Associative learning can be isolated and

measured using the 16-Picture PALT for an instrument.

4. The 16-Picture PALT is an adequate instrument for measuring associative learning.
5. Normal intelligence is a legitimate category.
6. Normal intelligence can be measured with the _Stanford-Binet Intelligence Scale, Form L-M_ being administered to second, fourth, and sixth grade students.
7. Title I student percentage is a legitimate way of categorizing schools on the socioeconomic dimension.
8. The second, fourth, and sixth grade pupils of the Oklahoma City Public School System may be considered a normal population.
9. The sample of schools and students may be considered of adequate size from which to generalize.

Population and Sample

The population from which the 180 _S_s of this study were chosen consisted of the entire second, fourth and sixth grades of the Oklahoma City Public School System (Table 1).

TABLE 1

ENROLLMENT* OF THE SECOND, FOURTH, AND SIXTH GRADES OF THE OKLAHOMA CITY PUBLIC SCHOOL SYSTEM

Grade	Number
Second	6,200
Fourth	5,912
Sixth	5,792
Total	17,904

*Figures released on September 5, 1969 by the Department of Research and Statistics of the Oklahoma City Public School System.

Delimitations

The study was limited to 180 subjects selected from the second, fourth, and sixth grades of three schools chosen randomly from these SES areas: Lower-White, Lower-Black, and Higher-White. Twenty subjects were selected from each grade level in each school. A subject was randomly selected and included upon obtaining an IQ score within the normal range (90-110) on the Stanford-Binet Intelligence Scale administered by one of the individual testing specialists employed for the experiment.

CHAPTER II

METHODOLOGY

That part of the study related to the identification of the associative learning rates of *Ss* involved individual testing sessions. This required four testers and 180 subjects from three schools representing three different socioeconomic levels.

Pre-experimental Procedures

Selection of Instruments. Three instruments were utilized in collecting the data for this experiment: (1) a standardized group IQ test, (2) the Stanford-Binet Intelligence Scale, and (3) the 16-Picture Paired-Associate Learning Task (PALT).

The Standardized IQ Tests. As a preliminary screening device, the experimenter established the fact that all *Ss* had been previously tested on a "standardized" IQ.test during the 1968-69 school year. This was done in an attempt to save the time. For instance if a subject was tested with the S-B and was not within the 90-110 range, the time and expense involved was lost for the purpose of the experiment. Therefore, the group test scores were used as an approximation with the S-B used to establish those *Ss* qualifying for participation in the experiment. The complete S-B was administered to 232 subjects in the effort to establish the sample of 180 *Ss*.

Test Instrument Utilized to Measure Associative Learning. The test instrument selected was the 16-Picture Paired-Associate Learning Task (PALT) which had been found effective by Hiner (1962), Welsh (1967), and Purdy (1968). Sixteen pairs were used because Welsh found this length to be the most significant in discriminating among learning rates in the subjects he studied.

Copies of the 16-Picture PALT were prepared for use by the four testing specialists (Appendix J). It was also necessary to design and produce copies of an answer recording sheet. A copy of this sheet is presented in Appendix C.

Validity and Reliability of Instruments. All instruments except the 16-Picture PALT have been thoroughly field tested or standardized and are considered to possess adequate validity and reliability.

In an effort to establish the reliability and validity of the 16-Picture PALT, an index of internal consistency was computed using the *Kuder-Richardson Formula 8* (1937). This test gave a reliability index for each of the 16 items. These indices ranged from .53 to .94. The concurrent validity was calculated using the S-B IQ scores as the external criterion and the number of trials recorded for each S as the predictor. The concurrent validity was calculated to be .4123. (A complete description of these procedures and the results are given in Appendix H.)

Approval to Conduct the Study. A formal request to conduct the study within the Oklahoma City Public School System was directed to the Director of Research and Statistics (Appendix A). On October 27, 1969, a letter of approval was received naming the school official through which the study was to be coordinated (Appendix B).

With the coordinator's assistance it was possible to obtain a list of all elementary schools in the Oklahoma City System which showed the necessary Title I qualifications and the percent of students with differing cultural backgrounds attending each of the schools.

Selection of Schools. Three lists were prepared from the master list of Oklahoma City Elementary Schools. One list contained the names of all the schools which served predominately the lower-black SES population. Another list included the names of the schools which served the lower-white SES population. The third list named the schools which served higher-white SES areas in which none of the students were from lower SES homes.

A table of random numbers (Edwards, 1969, p. 206) was used with each of the three lists in order to select the school from each list which would be involved. A meeting was arranged with the principal of each school to discuss all of the requirements and procedures of the study.

Experimental Procedures

Selection of Subjects. All students with normal intelligence, according to the records of the Oklahoma City School System, who were in the second, fourth, and sixth grades in each of the selected schools were included in a master list for each school by grade level.

A table of random numbers (Edwards, 1969, p. 206) was used to select the subjects for each school by grade level until 10 boys and 10 girls from each of the second, fourth, and sixth grades had met the selection criteria of normal intelligence on the complete S-B Scale, and cultural background characteristics as established when the study was planned.

The Testers. It was necessary to employ four specialists in administering individual tests to give the complete *Stanford-Binet Intelligence Scale* to each student who was tentatively selected as a subject. All of the examiners hold their Masters Degree and have had course work in individual testing techniques, including the S-B. All four examiners were recommended and approved by the Special Education Department at the University of Oklahoma and the Special Services Department of the Oklahoma City Public School System.

Each experimenter tested an equal number of subjects in each experimental group. This was done in order to afford a post-experimental analysis of experimenter effects.

Procedure. Each subject was tested individually in a room isolated from the interference of school activity. The subject was asked to sit to the left of, and at a right angle to, the examiner at the end of a table. Each subject was administered the S-B and the 16-Picture PALT. The entire subjects' testing was completed within a four-month time span as an attempt to control for historical confounding (i.e., confounding caused by the additional maturation of Ss over an extended period of time).

Directions for Administration. The following instructions were given to each subject:

> Here are a number of cards (the Examiner opens Booklet One). Each card in this set has two pictures on it (the Examiner shows the subject the sample pair). Look at both pictures carefully and try to remember which two pictures go together. (The Examiner then closes Booklet One and shows the subject Booklet Two.) Then I will show you another set of cards like these with only the first picture showing (the Examiner shows the sample card). I want you to tell me what picture went with this picture. (The Examiner pauses for the answer.) So, as you see the two pictures together, try to remember what two pictures went together (Welsh, 1967, p. 18).

If the subject failed to answer the sample card correctly, the examiner restated the appropriate instructions, repeating the example until he or she was satisfied the subject understood the nature of the task.

Then the paired pictures were presented singly to each subject at the rate of one every three seconds. Following this, Booklet Two was opened and the first picture of each pair was presented singly at the rate of one every five seconds. The examiner scored each oral response made by the subject. Additional trials were then administered until the subject reached the learning criterion of two successive, correct repetitions of the list. (No ceiling was placed on the number of trials or errors _Ss_ could experience.) Intertrial intervals were ten seconds in length. Between trials the examiner said:

"Now we will look at the pictures again. Try to remember what two pictures were together" (Welsh, . p. 19). If the subject questioned the examiner about the test, he or she added: "We will keep looking at the pairs of pictures until you learn all of them" (Welsh, p. 19).

After an explanation was made, a trial run was conducted to illustrate the complete procedure. Each examiner was instructed to use a typed instruction sheet each time the test was administered and to record the trials to criterion and errors on the individual record sheet. This record sheet contained the subject's number, grade, school, date examined, trials to criterion, number of errors for each trial, and the subject's age (Appendix C).

Analysis of the Data

The statistical analysis used in this study was a three-way analysis of variance (fixed model), followed by the _Duncan's Range Test_ (DRT), since these two tests are specifically suited for testing differences of _k_ means

(Winer, 1962). The data were tabled for analysis as demonstrated in Figure 1.

The following hypotheses concerning trials were tested with the analysis of variance (ANOVA) statistic: H_1, ANOVA (main effect of SES); H_2, ANOVA (main effect of grade level); H_3, ANOVA (main effect of testers); H_4, ANOVA (primary interaction of SES x grade level); H_5, ANOVA (primary interaction of SES and testers); H_6, ANOVA (primary interaction of grade level and testers); H_7, ANOVA (secondary interaction of SES, grade level, and testers).

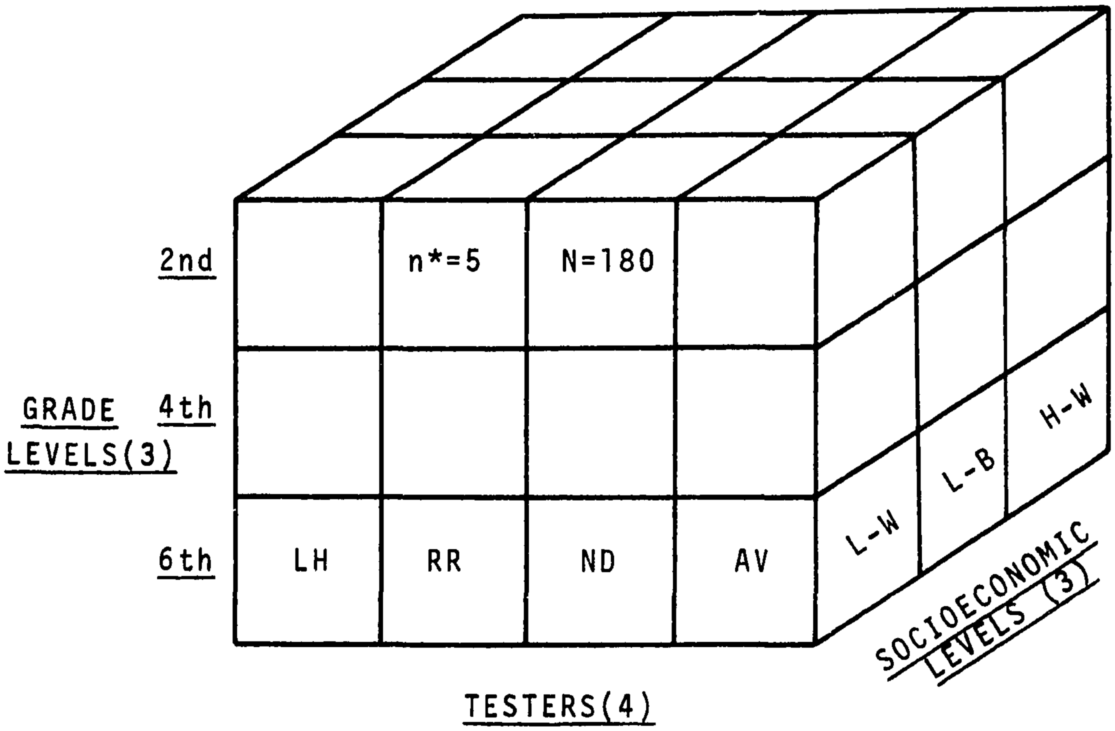
The following hypotheses concerning errors were tested with the analysis of variance statistic: H_1, ANOVA (main effect of SES on errors); H_2, ANOVA (main effect of grade level on errors); H_3, ANOVA (main effect of testers on errors); H_4, ANOVA (Primary interaction of SES and grade level); H_5, ANOVA (primary interaction of SES and testers); H_6, ANOVA (primary interaction of grade level and testers); H_7, ANOVA (secondary interaction between SES, grade level, and testers).

Concerning the formation of the *F* ratios, a technique devised by Glassman and Millman (1940) is used. The various *F* ratios and their derivations are presented in Appendix I.

Following the ANOVAs, the Duncan's Range Test (Winer, 1962) was applied to both the errors measure and the trials-to-criterion measure, as an attempt to locate

Figure 1

EXAMPLE OF A 3 x 3 x 4
ANALYSIS OF VARIANCE DESIGN



*In the smallest cell unit there were five subjects. There were 36 of these units which made a total of 180 subjects.

differences between specific groups. (All tests were at the .05 level.)

It seems appropriate at this point, to say the objective analysis of these data in the minute detail used was, in no way an attempt to degrade the work done by the four testers. The investigator was pursuing two major purposes in effecting such an analysis: 1) to present a thorough analysis of the present study--its virtues and its weaknesses and 2) to instigate further research in the area of paired-associate learning.

CHAPTER III

RESULTS

One hundred and eighty students from the Oklahoma City Public School System were tested to compare the rate of associative learning of three grades from each of three different socioeconomic areas.

F_{max} tests for homogeneity of variance for both the trial and error dependent measures were run to determine whether the assumption of homogeneity was met. Neither the error measure ($\underline{F}$ = 107.8861) nor the trial measure ($\underline{F}$ = 88.49) failed to meet the assumption of homogeneity of variance. Since this assumption was met, a three-way analysis of variance design (Winer, 1962) with SES, grade level, and experimenters as the factors identified as independent variables was performed in the statistical analysis of the data.

Analysis of Trials to Criterion

SES, Grade Level, and Testers

As stated previously, the basic theoretical assumptions underlying experimental hypotheses numbers 1, 2, and 3 are that differences in SES, grade level, and testers will result in a difference in the number of trials needed to learn the 16-Picture PALT. If these hypotheses are not supported, the experimental manipulation of SES, grade level, and testers loses its usefulness for the present study.

SES and Trials to Criterion (Hypothesis 1). The underlying assumptions concerning SES and trials to criterion can be tested by comparing the total number of trials required by all Ss in each SES. The Lower-White SES required 488 trials. The Lower-Black SES required 470 trials, and the Higher-White SES required 466 trials (Table 2).

TABLE 2

TOTAL NUMBER OF TRIALS TO CRITERION AS RELATED TO SES BY GRADE LEVEL (N-180)

Grade Level	SES Level		
	Lower-White	Lower-Black	Higher-White
2	203 trials	192 trials	197 trials
4	145 "	141 "	154 "
6	140 "	137 "	115 "
Total	488	470	466

Grade Level and Trials to Criterion (Hypothesis 2). The underlying assumption concerning grade level and trials to criterion can be tested by comparing the total trials required by all subjects in each grade level. The subjects of the second grade required a total of 592 trials to reach the learning criterion. The fourth grade required a total of 440. And the sixth grade required a total of 392 (Table 3).

TABLE 3

TOTAL NUMBER OF TRIALS TO CRITERION AS RELATED TO GRADE LEVEL BY TESTERS (N-180)

Tester	Grade Level		
	2nd	4th	6th
LH	171	104	86
RR	143	107	100
ND	172	141	111
AV	106	88	95
Total	592	440	392

<u>Testers and Trials to Criterion (Hypothesis 3)</u>. The underlying assumption of hypothesis 3 concerning testers and the total number of trials to criterion, is there will be a significant difference in the number of trials required to reach the learning criterion between the groups tested by the four different testers. The total trials required by each tester's groups are disclosed in Table 4. The total of all grade levels for tester LH

was 361. The total for tester RR was 350; for tester ND--424; and for tester AV--289.

TABLE 4

TOTAL NUMBER OF TRIALS TO CRITERION AS RELATED TO TESTERS BY GRADE LEVEL (N-180)

Grade Level	Testers			
	LH	RR	ND	AV
2	171	143	172	106
4	104	107	141	88
6	86	100	111	95
Total	361	350	424	289

Experimental Hypotheses Concerning Trials

Recall that the seven hypotheses regarding trials predicted no significant difference in trials to criterion between the three grade levels, the SES levels, between the four testers, or any significant interaction resulting from any combination of variables. Significant differences are revealed in Table 5 between the three grades, four testers, SES and grade level, SES and testers, grade level and testers, and between SES, grade level and testers.

Hypothesis 1, predicting no difference between *Ss*' performance from L-W, L-B, or H-W SES was supported (F = .6373, $P > .05$).

TABLE 5

ANALYSIS OF VARIANCE OF TRIALS TO CRITERION

Source of Variation	S.S.	df	MS	*F*	*P*
A (SES)	4.5776	2	2.2888	.6373	*
B (Grades)	363.3776	2	181.6888	50.5913	$<.001$
C (Testers)	203.8666	3	67.9555	18.9223	$<.001$
AB	389.4778	6	64.9129	18.0750	$<.001$
AC	250.7106	4	62.6776	17.4526	$<.001$
BC	677.3772	6	112.8962	31.4360	$<.001$
ABC	100.0340	12	8.3361	2.3211	$<.01$
within	517.1564	144	3.5913		
Total	2,506.5778	179			

*Not Significant

<u>Hypothesis 2</u>, predicting no difference between <u>S</u>s' performance from the second, fourth, or sixth grade was <u>not</u> supported (F = 50.5911, $P < .001$).

<u>Hypothesis 3</u>, predicting no difference between <u>S</u>s' performance resulting from being tested by different testers was <u>not</u> supported (F = 18.9223, $P < .001$).

<u>Hypothesis 4</u>, predicting no significant interaction between SES and grade levels was <u>not</u> supported (F = 18.0750, $P < .001$).

Hypothesis 5, predicting no significant interaction between SES and testers was *not* supported (F = 17.4535, $P < .001$).

Hypothesis 6, predicting no significant interaction between grade level and testers was *not* supported (F = 31.4360, $P < .001$).

Hypothesis 7, predicting no significant interaction between SES, grade level, and testers was *not* supported (F = 2.3211, $P < .01$).

Thus, the grade level and tester main effects were significant beyond the .001 level, and all of the primary and secondary interactions were significant from the .01 level to the .001 level.

The primary and secondary interactions of Table 5 need to be displayed in a manner that lends itself to a clear and simple interpretation--graphing.

Graphic Illustrations of Interaction

It is possible, and often profitable, to graph interactions. This is done by placing the experimental groups of one independent variable at equal intervals on the horizontal axis of the graph and the appropriate values of the dependent variable on the vertical axis. Then the mean values of another independent variable are plotted against the horizontal-axis group positions. In effect, what is shown is the relationship of one independent variable and the dependent variable against all levels of another independent variable.

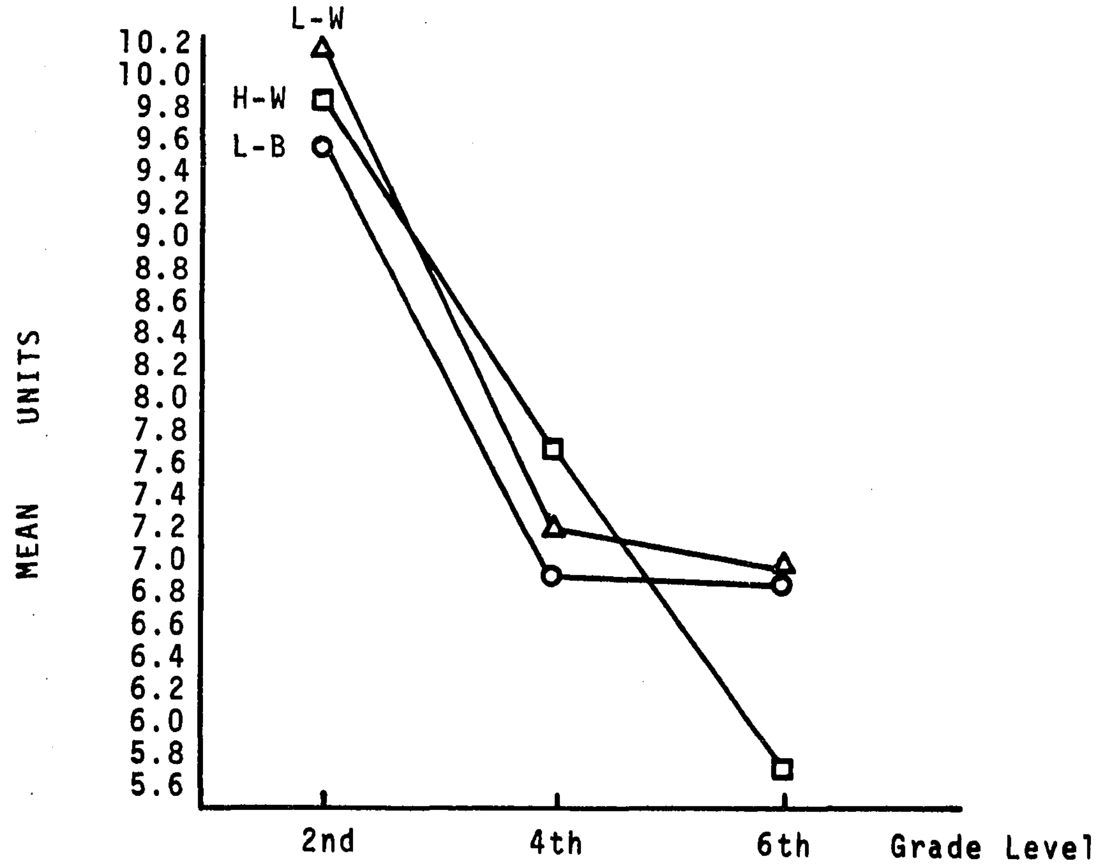
The slope of the lines roughly indicates the extent of the relation. If the plotted line is horizontal, obviously there is no relation. The nearer the line comes to being perpendicular--the higher the amount of interaction. If the lines formed by the second independent variable are parallel to each other, the interaction is approximately the same magnitude at each level. (For a more complete discussion of graphic displays of interaction, see Edwards, 1960; Lindquist, 1940; McNemar, 1955.)

The interactions of Table 5 are presented graphically in Figures 2-5. The plot of the interaction of SES x grade level (A x B) is shown in Figure 2. Figure 3 is a graphic display of the interaction of SES x testers (A x C). The interaction of grade level x testers (B x C) is shown in Figure 4, and the interaction of SES x grade level x testers (A x B x C) is exhibited in Figure 5. The mean values of the groups being graphed are given in the matrices accompanying the graphs. For Figure 5 the mean values are found on the following page in Table 6.

A significant interaction of SES and grade level (A x B) is presented in Figure 2. Because the slope of the lines between the 2nd and 4th grades is greater than the slope between the 4th and 6th grades, the interaction is shown to be significantly greater.

Figure 2

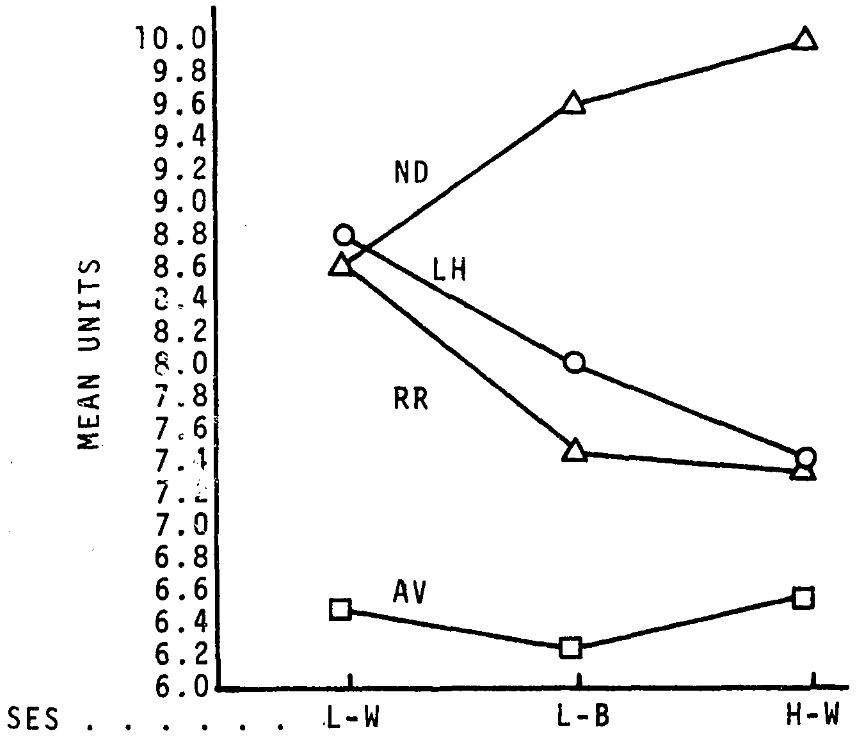
INTERACTION OF SES AND GRADE LEVEL (A x B)
CONCERNING TRIALS



	SES		
Grade	L-W	L-B	H-W
6th	7.00	6.90	5.75
4th	7.25	6.95	7.70
2nd	10.15	9.60	9.85

Figure 3

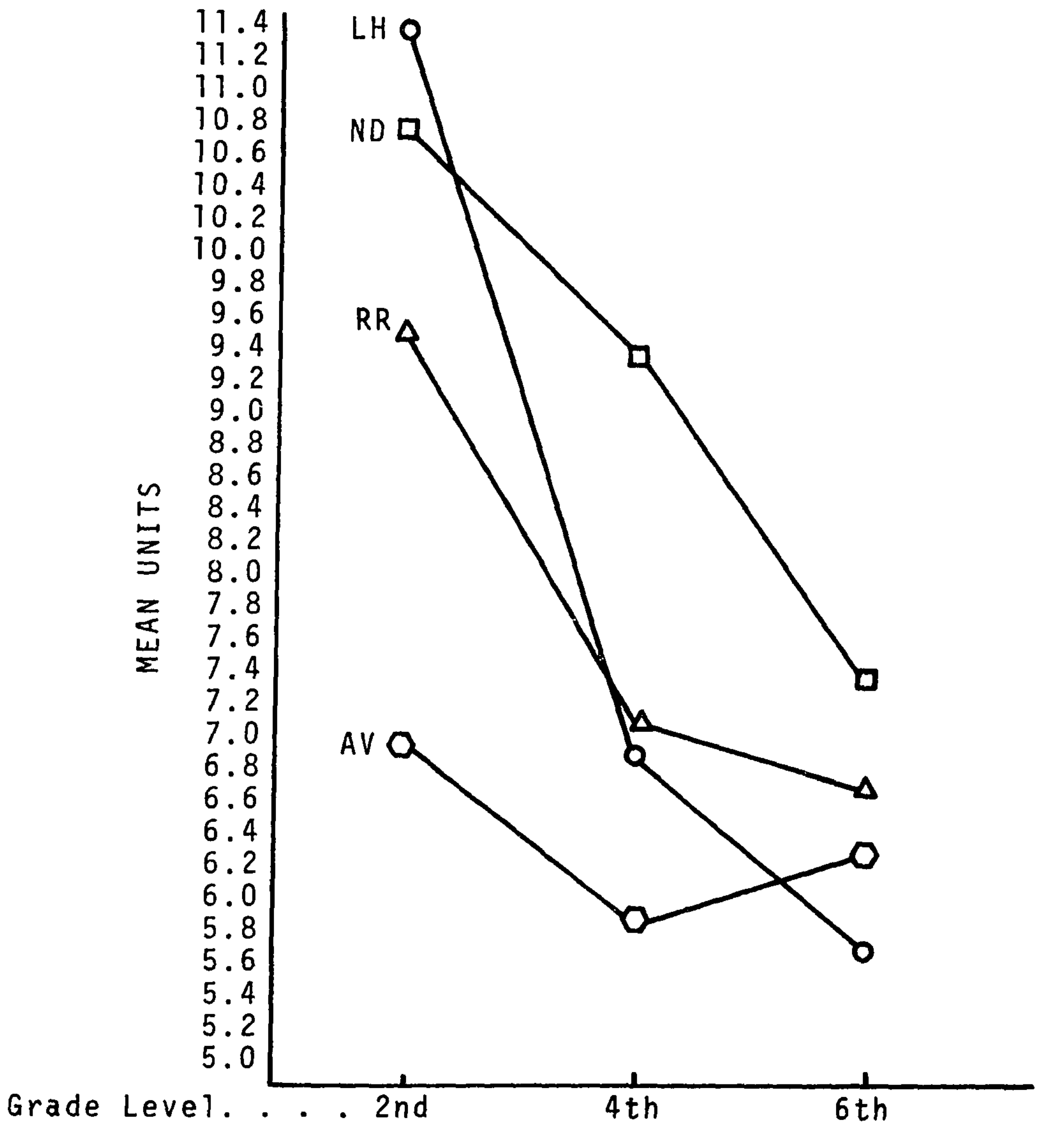
INTERACTION OF SES x TESTERS (A x C)
CONCERNING TRIALS



SES	TESTERS			
	LH	RR	ND	AV
L-W	8.73	8.66	8.66	6.46
L-B	8.00	7.40	9.60	6.33
H-W	7.33	7.26	10.00	6.46

FIGURE 4

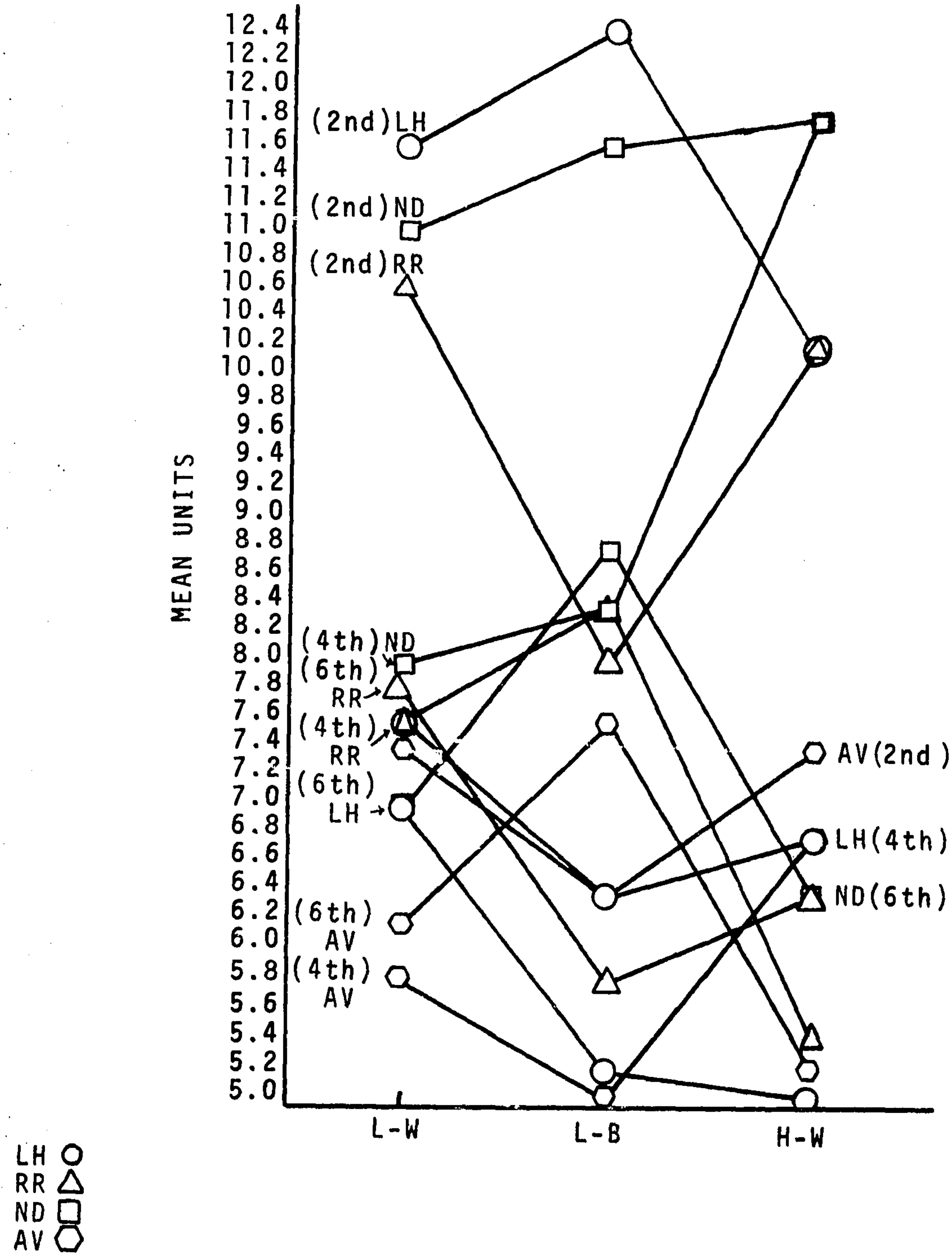
INTERACTION OF GRADE LEVEL AND TESTERS (B x C)
CONCERNING TRIALS



Grade Level	Testers			
	LH	RR	ND	AV
2nd	11.40	9.53	10.80	7.07
4th	6.93	7.13	9.40	5.87
6th	5.73	6.67	7.40	6.33

Figure 5

INTERACTION OF SES x GRADE LEVEL x TESTERS (A x B x C) CONCERNING TRIALS



(Means Table on following Page)

TABLE 6

MEANS FOR THE A x B x C INTERACTION
CONCERNING TRIALS

GRADE LEVELS	SES											
	L-W				L-B				H-W			
	Testers				Testers				Testers			
	LH	RR	ND	AV	LH	RR	ND	AV	LH	RR	ND	AV
2nd	11.6	10.6	11.0	7.4	12.4	8.0	11.6	6.4	10.2	10.2	11.8	7.4
		(Means)										
4th	7.6	7.6	8.0	5.8	6.4	8.4	8.4	5.0	6.8	5.4	11.8	6.8
6th	7.0	7.8	7.0	6.2	5.2	5.8	8.8	7.6	5.0	6.4	6.4	5.2

As was shown in Table 5 and in Figures 2-5, the main effects were not significant while the interactions were significant. This suggests that further analysis needs to be done in an attempt to locate the particular differences. The Duncan's Range Test was the statistic used in this analysis. The results of this test are recorded in Table 7.

TABLE 7

RESULTS OF DUNCAN'S RANGE TEST (DRT) ON TRIALS

Group Code		Grade	SES	Tester		Group Code		Grade	SES	Tester
x	=	4	L-B	AV	Required fewer trials than.........	c	=	2	L-W	ND
						k	=	2	L-B	ND
						b	=	2	L-W	LH
						s	=	4	H-W	ND
						g	=	2	H-W	ND
						i	=	2	L-B	LH
cc	=	6	H-W	LH	"	k	=	2	L-B	ND
						b	=	2	L-W	LH
						s	=	4	H-W	ND
						g	=	2	H-W	ND
						i	=	2	L-B	LH
ff	=	6	H-W	AV	"	k	=	2	L-B	ND
						b	=	2	L-W	LH
						s	=	4	H-W	ND
						g	=	2	H-W	ND
						i	=	2	L-B	LH
gg	=	6	L-B	LH	"	k	=	2	L-B	ND
						b	=	2	L-W	LH
						s	=	4	H-W	ND
						g	=	2	H-W	ND
						i	=	2	L-B	LH
r	=	4	H-W	RR	"	k	=	2	L-B	ND
						b	=	2	L-W	LH
						s	=	4	H-W	ND
						g	=	2	H-W	ND
						i	=	2	L-B	LH
hh	=	6	L-B	RR	"	k	=	2	L-B	ND
						b	=	2	L-W	LH
						s	=	4	H-W	ND
						g	=	2	H-W	ND
						i	=	2	L-B	LH
p	=	4	L-W	AV	"	k	=	2	L-B	ND
						b	=	2	L-W	LH
						s	=	4	H-W	ND
						g	=	2	H-W	ND
						i	=	2	L-B	LH

TABLE 7 (Cont'd)

Group Code		Grade	SES	Tester		Group Code		Grade	SES	Tester
bb	=	6	L-W	AV	Required fewer trials than.........	s g i	= = =	4 2 2	H-W H-W L-B	ND ND LH
ee	=	6	H-W	ND	"	i	=	2	L-B	LH
dd	=	6	H-W	RR	"	i	=	2	L-B	LH
u	=	4	L-B	LH	"	i	=	2	L-B	LH
l	=	2	L-B	AV	"	i	=	2	L-B	LH
t	=	4	H-W	AV	"	i	=	2	L-B	LH
q	=	4	H-W	LH	"	i	=	2	L-B	LH
aa	=	6	L-W	ND	"	i	=	2	L-B	LH
y	=	6	L-W	LH	"	i	=	2	L-B	LH

Figure 6

OVERLAP OF SIGNIFICANT GROUPS

Significant Groups																	
Row 1	x	cc ff gg r hh p			bb		ee	dd	u	l	t	q	aa	y			
Row 2	c		k	b	s	g									i		

<u>Instructions for Reading Figure 6</u>. All of the groups represented by letters in row one required significantly fewer trials than the groups represented by letters in row 2 <u>to the right of their position</u>. For example, <u>x</u> in row 1 required significantly fewer trials than <u>c</u>,<u>k</u>,<u>b</u>, <u>s</u>,<u>g</u>, and <u>i</u> in row 2; <u>x</u>,<u>cc</u>,<u>ff</u>,<u>gg</u>,<u>r</u>,<u>hh</u>, and <u>p</u> in row 1

required significantly fewer trials than k,b,s,g, and i in row 2; x,cc,ff,gg,r,hh,p, and bb in row 1 required significantly fewer trials than s,g, and i in row 2; and x,cc,ff, gg,r,hh,p,bb,ee,dd,u,l,t,q,aa, and y in row 1 required significantly fewer trials than i in row 2.

Interpretation of Significant Group Clusters Following the Duncan's Range Test on Trials

TABLE 8

PATTERNS OF MEANS RESULTING FROM THE DRT CONCERNING TRIALS AND SES

Grade Level	SES Level			
	Lower-White	Lower-Black	Higher-White	
2	0	1	0	
4	5	7	7	
6	5	10	12	
Totals	10	18	19	47

The data in Table 8 disclose that 10 of the group differences were accounted for by the L-W SES; 18 were credited to the L-B SES; and 19 of the group differences were assigned to the H-W SES. These seem to be fairly well distributed over the three different SES levels.

A Chi Square test was performed on the data in Table 8. The results were that the three SES levels are not significantly different from chance expectation ($X^2 = 3.06$; d.f. = 2; $P > .05$).

Data in Table 9 reveal that 13 of the 47 group differences were recorded by LH. While RR had 11 of the 47 significant group differences, ND showed only two group differences of the total 47, and AV showed a total of 21 group differences of the total 47. These proportions would indicate that ND and AV have scored their Ss significantly higher and lower, respectively, than RR or LH.

A Chi Square test revealed that the difference between the way the different testers scored the number of trials for Ss was significant ($X^2 = 8.49$; d.f. 3; $P < .05$).

TABLE 9

PATTERNS OF MEANS RESULTING FROM THE DRT CONCERNING TRIALS AND TESTERS

Grade Level	Testers				
	LH	RR	ND	AV	
2	0	0	0	1	
4	2	5	0	12	
6	11	6	2	8	
Totals	13	11	2	21	47

The data in Table 10 show that only 1 of the 47 group differences was recorded for the second grade. Nineteen were recorded for the fourth grade, and 27 of the

47 group differences were credited to the sixth-grade Ss. These totals seem to be unevenly distributed, with the second-grade Ss receiving too few and the sixth-grade Ss receiving too many to attribute these findings to chance.

A Chi Square test revealed that the difference was highly significant ($X^2 = 32.12$; d.f. 2; $P < .001$).

TABLE 10

PATTERNS OF MEANS RESULTING FROM THE DRT CONCERNING TRIALS AND GRADE LEVELS

SES	Grade Level: 2nd	4th	6th	
L-W	0	5	5	
L-B	1	7	10	
H-W	0	7	12	
Totals	1	19	27	47

Summary of DRT on Trials

In summation, one could say that the significant group differences occurred within the grade levels and testers, but not within the SES levels. The grade levels accounted for the greatest discrepancy.

Interpretation of Results of the ANOVA of Trials

Interpretation of the Main Effect of Socioeconomic Status. The different schools from the different socioeconomic levels did not cause a significant difference in number of trials each group needed to learn the 16-Picture PALT (*F* = .6375, $P > .05$).

Interpretation of the Main Effect of Grades. There was a significant difference among the groups coming from different grade levels (*F* = 50.5911, $P < .001$).

Interpretation of the Main Effect of Testers. The different testers caused a significant difference in the number of trials needed between groups to learn the 16-Picture PALT (*F* = 18.9223, $P < .001$).

Socioeconomic Status X Grade Level Interaction (A x B). The A x B interaction was significant (*F* = 18.0750, $P < .001$). This reveals that SES and grade levels make a unique interaction contribution (i.e., different grade levels have a significant interaction when combined with different SESs).

Socioeconomic Status X Testers Interaction (A x C). The A x C interaction was significant (*F* = 17.4526, $P < .001$). This indicates that when different testers were working with *Ss* from different SESs the resultant interaction between the tester and SES caused significant differences in the number of trials needed by the groups within the experiment.

Grade Level x Testers Interaction (B x C). The B x C interaction was significant (*F* = 31.4360, $P < .001$). The interpretation of this *F* value would mean that the unique contribution of grade level interacting with testers caused a significant difference among the different groups as to the number of trials it took to meet the learning criterion on the 16-Picture PALT.

Socioeconomic Status x Grade Level x Testers Interaction (A x B x C). The A x B x C interaction was significant ($\underline{F}$ = 2.3211, $P < .01$). This means that the unique effect caused by combining SES with grade levels and testers made a significant difference in the number of trials needed by the individual groups in meeting the learning criterion on the 16-Picture PALT.

Summary of ANOVA of Trials

The analysis of variance of the trials recorded for the 180 Ss showed no significant difference caused by SES levels; however, the grade levels and testers did cause a difference in the trials scores. All interactions were significant from the .01 level to the .001 level. Because of the significance of these interactions, this would indicate at least two possible conditions: (1) The 16-Picture PALT is extremely sensitive to the effects of interaction and, if this is so, (2) The conditions of test administration need to be more strictly controlled.

Analysis of Errors to Criterion

SES, Grade Level, Testers, and Errors to Criterion

The basic theoretical assumptions underlying experimental hypotheses 1, 2, and 3 concerning errors are that differences in levels of these independent variables will cause a significant difference in the number of errors committed by the different groups of Ss. If these hypotheses are not supported, the experimental manipulation of SES, grade level, and test administrators loses its usefulness for the present study.

SES and Errors to Criterion (Hypothesis 1). The underlying assumption concerning SES and errors to criterion can be tested by comparing the total number of errors committed by all subjects in each SES. These data are given in Table 11. The Ss of the Lower-Black SES committed a total of 2,565 errors. The Ss of the Lower-White SES committed a total of 2,813 errors in meeting the learning criterion of the 16-Picture PALT. The Ss of the Higher-White SES committed a total of 2,429 errors during the learning session.

TABLE 11*

TOTAL NUMBER OF ERRORS TO CRITERION AS RELATED TO SES BY GRADE LEVEL (N-180)

Grade Level	SES Level		
	Lower-White	Lower-Black	Higher-White
2	1,255	1,092	1,085
4	765	700	830
6	793	773	514
Total	2,813	2,565	2,429

*Perhaps a word of explanation concerning the tabular presentation of raw data is in order. In both the trials and errors hypotheses, the three main effects of SES, grade level, and testers are tabled showing the number of trials and errors given to each category of the particular independent variable being considered. The independent variable in question is listed always at the top of the table. (In the case of Table 11, the independent variable being considered is SES level.) This manner of presenting raw data remains constant throughout the study.

Grade Level and Errors to Criterion (Hypothesis 2). The underlying assumption concerning grade level and errors to criterion can be tested by comparing the total number of errors committed by all subjects in each grade level. These data are given in Table 12. The Ss of the second grade committed a total of 3,432 errors; the fourth grade 2,295 errors; and the sixth grade 2,080 errors. All of these errors were committed during the time the Ss were trying to achieve the learning criterion on the 16-Picture PALT.

TABLE 12

TOTAL NUMBER OF ERRORS TO CRITERION AS RELATED TO GRADE LEVEL BY TESTER (N-180)

Tester	Grade Level		
	2nd	4th	6th
LH	968	574	454
RR	737	480	520
ND	1,095	809	585
AV	632	432	521
Total	3,432	2,295	2,080

Testers and Errors to Criterion (Hypothesis 3). The underlying assumption concerning testers and the total number of errors committed by the Ss in achieving learning criterion on the 16-Picture PALT, is there will be a significant difference in the number of errors committed by the groups tested by the four different testers. The total errors committed by each tester's groups are displayed in Table 13. The total of all grade levels for tester LH was 1,996; for tester RR the total was 1,737; for tester ND the total was 2,489; and for tester AV the total was 1,585.

TABLE 13

TOTAL NUMBER OF ERRORS TO CRITERION AS RELATED TO TESTERS BY GRADE LEVEL (N-180)

Grade Level	Testers			
	LH	RR	ND	AV
2	968	737	1,095	632
4	574	480	809	432
6	454	520	585	521
Total	1,996	1,737	2,489	1,585

Experimental Hypotheses Concerning Errors

The seven hypotheses concerning errors predicted no significant difference in the number of errors committed by _S_s between the three SES groups, between the three grade levels, or between the four testers. It was further predicted that no interaction among variables would affect the number of errors recorded.

The data in Table 14 manifest significant differences caused by the grade levels and testers but not by SES. Significant interactions were caused by SES and grade level; SES and testers; grade level and testers; and SES, grade level, and testers.

TABLE 14

ANALYSIS OF VARIANCE OF ERRORS TO CRITERION

Source of Variation	S.S.	df	MS	F	P
A (SES)	1,260.6444	2	630.3222	2.9665	*
B (Grades)	17,593.8778	2	8,796.9389	41.4018	$<.001$
C (Testers)	10,471.5277	3	3,490.5092	16.4277	$<.001$
AB	21,363.7112	6	3,560.6185	16.7571	$<.001$
AC	14,728.0606	4	3,682.0151	17.3290	$<.001$
BC	32,713.3940	6	5,452.2323	25.6603	$<.001$
ABC	5,222.1453	12	435.1787	2.0481	$<.05$
within	30,596.7002	144	212.4770		
Total	133,950.0612	179			

*Not Significant

Hypothesis 1, predicting no difference between the number of errors committed by Ss from L-W, L-B, or H-W SES was supported ($F = 2.9665$, $P > .05$).

Hypothesis 2, predicting no difference between the number of errors committed by Ss from the second, fourth, and sixth grades was not supported ($F = 41.4018$, $P < .001$).

Hypothesis 3, predicting no difference between the number of errors committed by Ss who were tested by different experimenters was not supported ($F = 16.4277$, $P < .001$).

Hypothesis 4, predicting no difference between the number of errors committed as a result of interaction between SES and grade level was not supported ($\underline{F}$ = 16.7571, P $<$ .001).

Hypothesis 5, predicting no difference between groups as a result of errors committed attributable to the interaction between SES and testers was not supported ($\underline{F}$ = 17.3290, P $<$ .001).

Hypothesis 6, predicting no difference between groups as a result of errors committed attributable to the interaction of grade level and testers was not supported ($\underline{F}$ = 25.6603, P $<$ .001).

Hypothesis 7, predicting no difference between groups as a result of errors committed attributable to the interaction of SES, grade level, and testers was not supported ($\underline{F}$ = 2.0481, P $<$ .05).

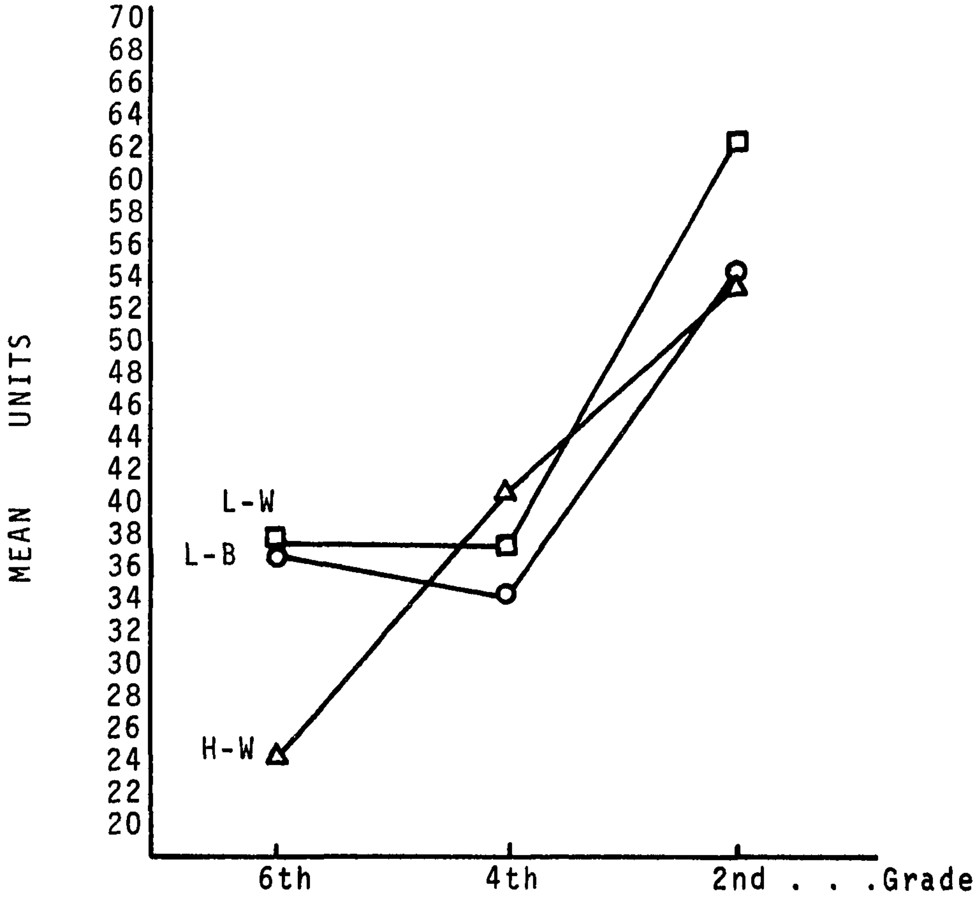
Graphic Illustration of Interactions of the ANOVA of Errors

As in the case of trials, two of the main effects were significant, while all of the first and second order interactions were significant. These interactions were presented graphically in Figures 7-10. Figure 7 is a graphic presentation of the SES and grade level (A x B) interaction on the error scores. Figure 8 is a graphic illustration of the SES x testers interaction (A x C). Figure 9 is a plot of the grade level x testers (B x C) interaction. Figure 10 is a graphic presentation of the

SES x grade level x testers (A x B x C) interaction. All of the means used in graphing are presented with the graphs except the (A x B x C) graph. The means for this graph are presented in Table 15.

Figure 7

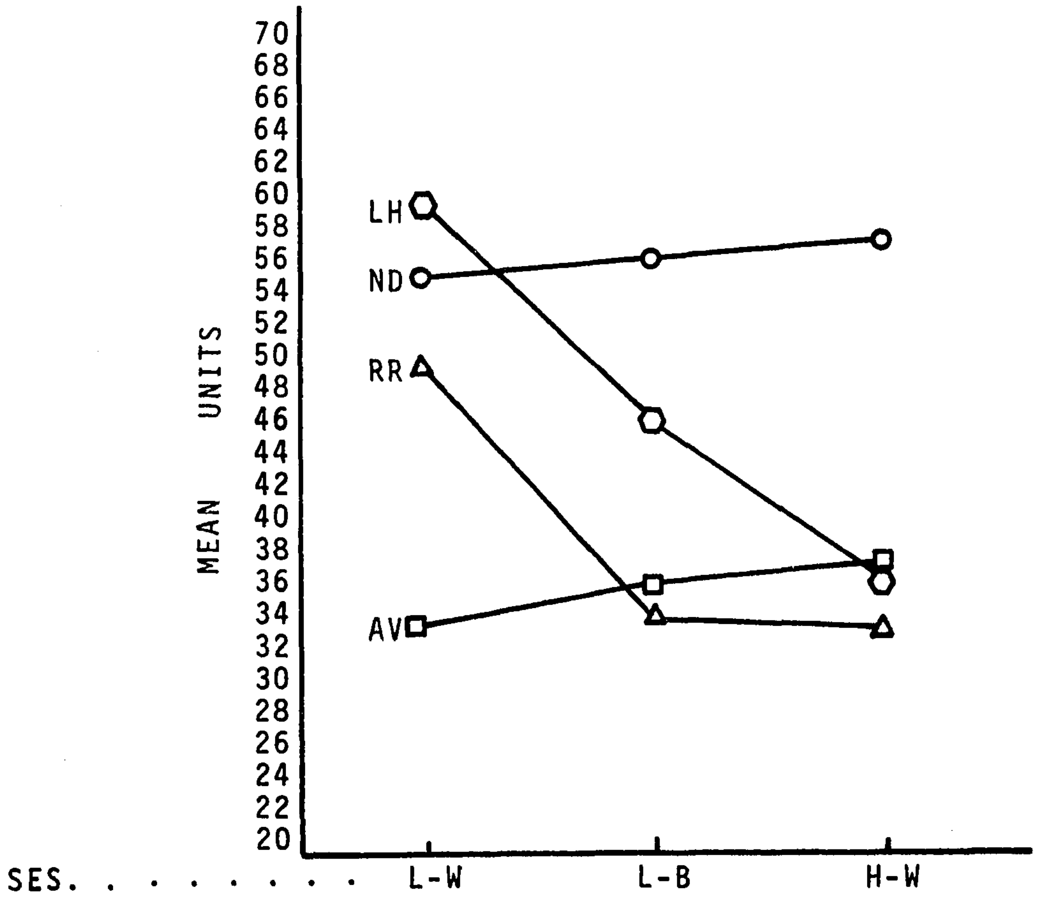
INTERACTION OF SES AND GRADE LEVEL (A x B)
CONCERNING ERRORS



Grade Level	SES		
	L-W	L-B	H-W
2nd	62.75	54.60	54.25
4th	38.25	35.00	41.50
6th	39.67	38.67	25.70

Figure 8

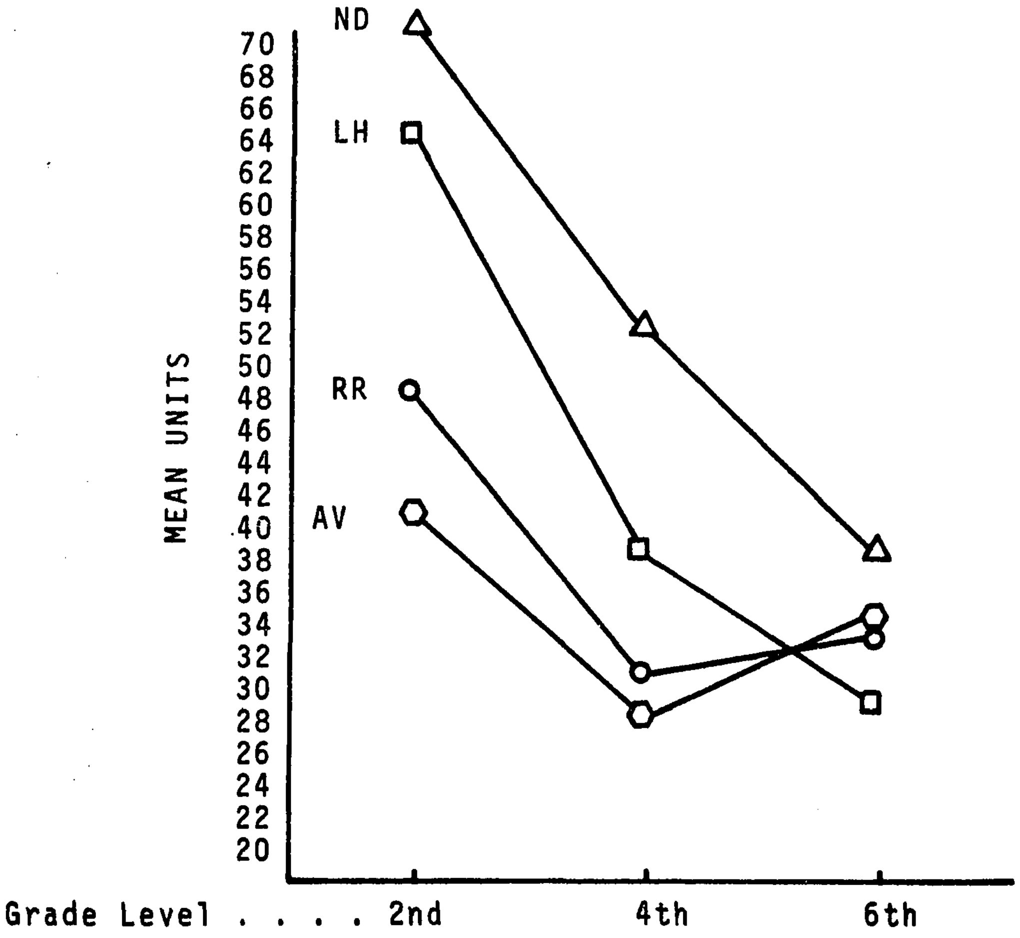
INTERACTION OF SES AND TESTERS (A x C)
CONCERNING ERRORS



SES	Testers			
	LH	RR	ND	AV
L-W	58.67	49.07	54.33	33.27
L-B	45.93	34.00	55.67	36.00
H-W	36.27	32.73	56.53	36.40

Figure 9

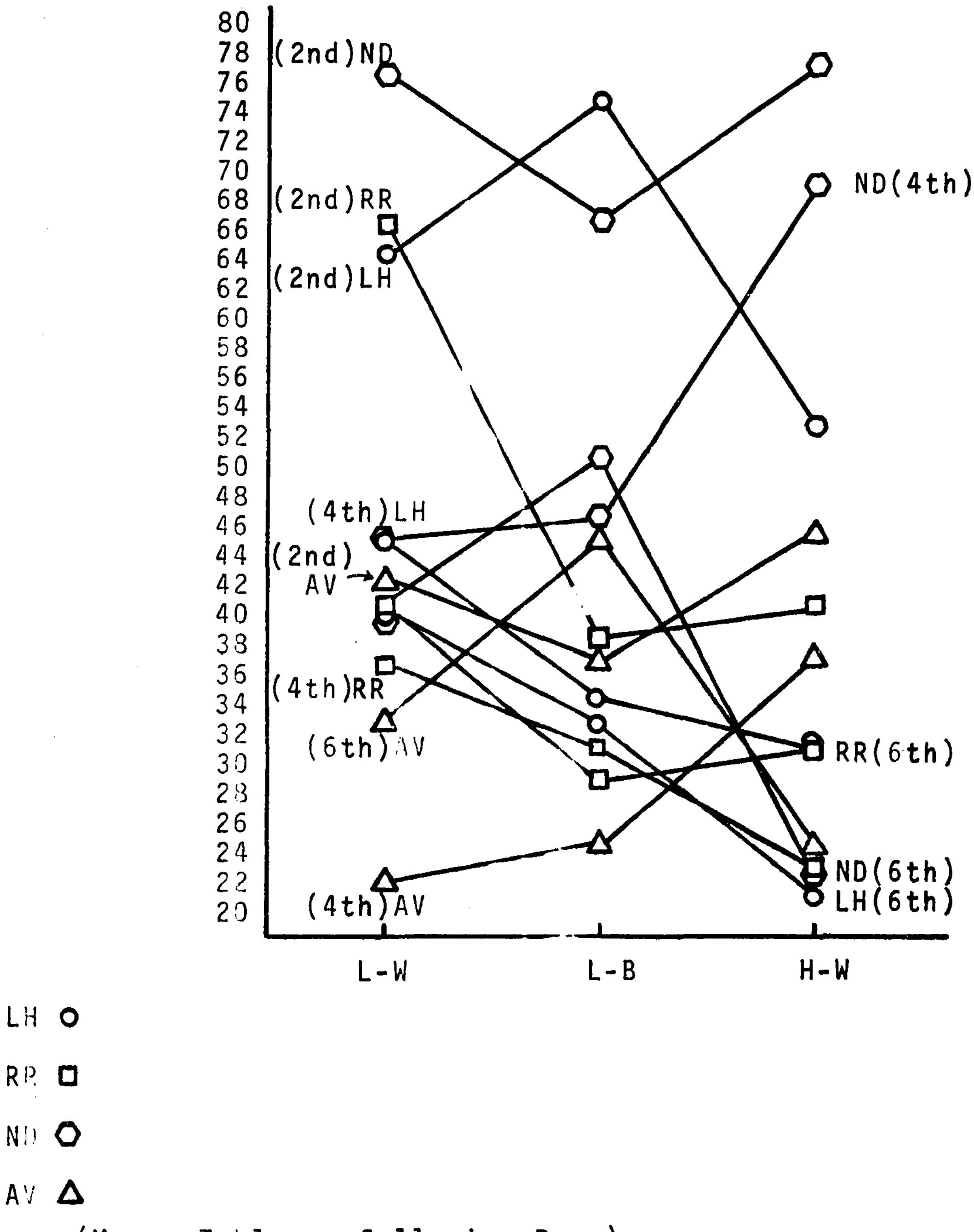
INTERACTION OF GRADE LEVEL AND TESTERS (B x C)
CONCERNING ERRORS



Grade Level	Testers			
	LH	RR	ND	AV
2nd	64.53	49.13	73.00	42.13
4th	38.93	32.00	53.93	28.80
6th	30.27	34.67	39.00	34.73

Figure 10

INTERACTION OF SES x GRADE LEVEL x
TESTERS (A x B x C) CONCERNING ERRORS



(Means Table on following Page)

TABLE 15

MEANS FOR THE A x B x C INTERACTION
CONCERNING ERRORS

GRADE LEVELS	SES: L-W				L-B				H-W			
	LH	RR	ND	AV	LH	RR	ND	AV	LH	RR	ND	AV
2nd	65.2	67.6	75.6	42.6	75.2	38.8	66.8	37.6	53.2	41.0	76.6	46.2
4th	46.0	37.8	46.0	23.2	35.2	33.2	46.8	24.8	33.6	25.0	69.0	38.4
6th	41.4	41.8	41.4	34.0	34.0	30.0	51.6	45.6	22.0	32.2	24.0	24.6

As in the case of trials, the Duncan's Range Test was performed on the error scores as an attempt to locate specific differences. The results of this test are recorded in Table 16.

TABLE 16

RESULTS OF DUNCAN'S RANGE TEST ON ERRORS

Group Code		Grade	SES	Tester		Group Code		Grade	SES	Tester
						b	=	2	L-W	LH
						k	=	2	L-B	ND
					Made fewer	d	=	2	L-W	RR
cc	=	6	H-W	LH	errors than	s	=	4	H-W	ND
						i	=	2	L-B	LH
						c	=	2	L-W	ND
						g	=	2	H-W	ND
						b	=	2	L-W	LH
						k	=	2	L-B	ND
						d	=	2	L-W	RR
ff	=	6	H-W	AV	"	s	=	4	H-W	ND
						i	=	2	L-B	LH
						c	=	2	L-W	ND
						g	=	2	H-W	ND
						b	=	2	L-W	LH
						k	=	2	L-B	ND
						d	=	2	L-W	RR
p	=	4	L-W	AV	"	s	=	4	H-W	ND
						i	=	2	L-B	LH
						c	=	2	L-W	ND
						g	=	2	H-W	ND
						b	=	2	L-W	LH
						k	=	2	L-B	ND
						d	=	2	L-W	RR
x	=	4	L-B	AV	"	s	=	4	H-W	ND
						i	=	2	L-B	LH
						c	=	2	L-W	ND
						g	=	2	H-W	ND
						b	=	2	L-W	LH
						k	=	2	L-B	ND
						d	=	2	L-W	RR
ee	=	6	H-W	ND	"	s	=	4	H-W	ND
						i	=	2	L-B	LH
						c	=	2	L-W	ND
						g	=	2	H-W	ND

TABLE 16 (Cont'd)

Group Code	Grade	SES	Tester		Group Code	Grade	SES	Tester
r =	4	H-W	RR	Made fewer errors than	b =	2	L-W	LH
					k =	2	L-B	ND
					d =	2	L-W	RR
					s =	4	H-W	ND
					i =	2	L-B	LH
					c =	2	L-W	ND
					g =	2	H-W	ND
gg =	6	L-B	LH	"	b =	2	L-W	LH
					k =	2	L-B	ND
					d =	2	L-W	RR
					s =	4	H-W	ND
					i =	2	L-B	LH
					c =	2	L-W	ND
					g =	2	H-W	ND
hh =	6	L-B	RR	"	k =	2	L-B	ND
					d =	2	L-W	RR
					s =	4	H-W	ND
					i =	2	L-B	LH
					c =	2	L-W	ND
					g =	2	H-W	ND
dd =	6	H-W	RR		s =	4	H-W	ND
					i =	2	L-B	LH
					c =	2	L-W	ND
					g =	2	H-W	ND
v =	4	L-B	RR	"	s =	4	H-W	ND
					i =	2	L-B	LH
					c =	2	L-W	ND
					g =	2	H-W	ND
q =	4	H-W	LH	"	s =	4	H-W	ND
					i =	2	L-B	LH
					c =	2	L-W	ND
					g =	2	H-W	ND
bb =	6	L-W	AV	"	i =	2	L-B	LH
					c =	2	L-W	ND
					g =	2	H-W	ND

TABLE 16 (Cont'd)

Group Code		Grade	SES	Tester		Group Code		Grade	SES	Tester
u	=	4	L-B	LH	Made fewer errors than	i	=	2	L-B	LH
						c	=	2	L-W	ND
						g	=	2	H-W	ND
l	=	2	L-B	AV	"	i	=	2	L-B	LH
						c	=	2	L-W	ND
						g	=	2	H-W	ND
n	=	4	L-W	RR	"	i	=	2	L-B	LH
						c	=	2	L-W	ND
						g	=	2	H-W	ND
t	=	4	H-W	AV	"	i	=	2	L-B	LH
						c	=	2	L-W	ND
						g	=	2	H-W	ND
j	=	2	L-B	RR	"	i	=	2	L-B	LH
						c	=	2	L-W	ND
						g	=	2	H-W	ND
f	=	2	H-W	RR	"	i	=	2	L-B	LH
						c	=	2	L-W	ND
						g	=	2	H-W	ND
y	=	6	L-W	LH	"	i	=	2	L-B	LH
						c	=	2	L-W	ND
						g	=	2	H-W	ND
aa	=	6	L-W	ND	"	i	=	2	L-B	LH
						c	=	2	L-W	ND
						g	=	2	H-W	ND
z	=	6	L-W	RR	"	i	=	2	L-B	LH
						c	=	2	L-W	ND
						g	=	2	H-W	ND
a	=	2	L-W	AV	"	i	=	2	L-B	LH
						c	=	2	L-W	ND
						g	=	2	H-W	ND

Figure 11

OVERLAP OF SIGNIFICANT GROUPS*

Row 1 cc ff p x ee r gg hh dd v q bb u l n t j f y aa z a

Row 2 b k d s i c g

*All of the groups represented by letters in row one made significantly fewer errors than the groups represented by letters in row 2 <u>to the right of their position</u>.

Interpretation of Significant Group-difference Clusters Following the DRT on Errors. In regard to the significant group differences, (100) the results are shown in Tables 17, 18, and 19.

Data in Table 17 depict that 25 of the group differences were credited to the L-W SES; while 33 were accounted for by the L-B SES; and the H-W SES had 42 of the 100 significant group differences.

A Chi Square test revealed that the three SES levels are not significantly different from chance expectation ($X^2 = 4.06$; d.f. = 2; $P > .05$).

TABLE 17

PATTERNS OF MEANS RESULTING FROM THE DRT CONCERNING ERRORS AND SES

Grade Level	SES Level			
	Lower-White	Lower-Black	Higher-White	
2	3	6	3	
4	10	14	14	
6	12	13	25	
Totals	25	33	42	100

Figures in Table 18 reveal that 24 of the 100 group differences were tested by LH and 33 were tested by RR. ND was credited with 10 of the 100 and AV was responsible for 33.

TABLE 18

PATTERNS OF MEANS RESULTING FROM THE DRT CONCERNING ERRORS AND TESTERS

Grade Level	Testers				
	LH	RR	ND	AV	
2	-	6	-	6	
4	7	14	-	17	
6	17	13	10	10	
Totals	24	33	10	33	100

A Chi Square was performed on the data in an attempt to determine if the four testers had scored the errors for all Ss in a significantly different manner. The resultant Chi Square revealed that the testers had, in fact, scored the errors in a significantly different manner ($X^2 = 14.16$; with 3 d.f.; $P < .01$).

Data in Table 19 disclose that 12 of the significant group differences were scored by the second grade; the fourth grade is credited with 38; and the sixth grade had a total of 50 of the 100 significant group differences. These seem to be skewed out of proportion for the different grade levels.

The resultant Chi Square showed the grades to be credited with significantly different numbers of the group differences ($X^2 = 22.67$; d.f. = 2; $P < .001$).

TABLE 19

PATTERNS OF MEANS RESULTING FROM THE DRT
CONCERNING ERRORS AND GRADE LEVELS

SES	Grade Level 2nd	4th	6th	
L-W	3	10	12	
L-B	6	14	13	
H-W	3	14	25	
Totals	12	38	50	100

Summary of DRT on Errors. The application of the DRT to the means of the groups involved in the study revealed some significant patterns. It is at this point the interaction of the testers and *S*s begins to make significant impressions on the scores recorded for the *S*s. For instance, if one of the groups of a particular grade in school "X" appeared within the top five groups when they were tested by any three of the testers but failed to appear in the top 50 when tested by the fourth tester, there is a strong possibility that the *S*s of that group and tester number four are experiencing some sort of dysfunctional interaction. This would offer strong support to the results of the ANOVA of trials and errors. On the other hand, if a group is scored significantly higher than the other three groups from that SES and grade level it would suggest a facilitating or functional interaction exists between the tester and the *Ss*. Since the *Ss* of each SES and each grade level were randomly assigned to the testers, it can be said in a general way that any time one group was *isolated* from the other three groups from his grade level and SES, there exists a strong possibility of a functional or dysfunctional interaction between the tester and *Ss* of the group.

Interpretation of Results of the ANOVA of Errors

Interpretation of the Main Effect of Socioeconomic Status. The different schools from the different socioeconomic levels did not cause a significant difference in the number of errors each group committed while learning the 16-Picture PALT (F = 2.9665, $P > .05$).

Interpretation of the Main Effect of Grades. There was a significant difference between the groups coming from different grade levels (F = 41.4018, $P < .001$). Those *Ss* from the lower grades generally made more errors than *Ss* from the higher grades. Even though some of the differences were quite small, the overall effect was significant.

Interpretation of the Main Effect of Testers. The different testers did cause a significant mean difference in the number of errors committed between groups in learning the 16-Picture PALT (F = 16.4277, $P < .001$).

<u>(A x C) Interaction</u>. $A > .05$ and $C < .001$; however, when these two were paired in the experimental situation they had an exponential effect ($F = 17.3290$, $P < .001$). This would mean that when the individual testers were operating in different schools the resultant effect was that the interaction between the testers and schools caused significant differences in the error scores of the different groups.

<u>(B x C) Interaction</u>. The B x C interaction was significant ($F = 25.6603$, $P < .001$). The interpretation of this F value would mean that the unique contribution of grades as they are interacting with testers caused a significant difference among the different group means. In other words, the effect of grades and testers made a significant difference in the number of errors committed to meet the learning criterion on the 16-Picture PALT.

<u>Interpretation of A x B x C Interaction</u>. The interaction of the A x B x C effect was significant ($F = 2.0481$, $P < .05$). This means that the unique effect caused by testers interacting with grades interacting with SES made a significant difference in the number of errors committed for different groups to learn the 16-Picture PALT.

Summary of ANOVA of Errors

The analysis of variance of the errors scores almost coincides with the ANOVA of the trials, and to reiterate the findings would simply be redundant. In fact, the DRT difference patterns which were tested with a Chi Square statistic showed significant differences in the grade-levels and testers variables but not in the SES levels.

The same recommendations and conclusions would be in order for the ANOVA of error scores as were given for the ANOVA of trials scores.

CHAPTER IV

DISCUSSION

In the discussion of why the null hypotheses of the main effect of socioeconomic levels (three) failed to be rejected three alternatives were considered: (1) The theory is inaccurate; (2) The theory is correct but was mis-applied; and (3) There were improper judgments or evaluations. In addition, implications for further research are discussed.

The Theory Is Inaccurate

The theoretical foundation for this study was based upon the relationship between the trial and error score for each of the subjects and the socioeconomic status, grade level and tester of the particular subject. The trial and error scores were used for the individual Ss. A 3 x 3 x 4 analysis of variance was used to test the effect of each of the independent variables on the number of trials needed and errors recorded in the learning of the 16-Picture PALT. A significant discrepancy was expected between the students of different SES levels. It was at this point that the theory was not supported.

One of the first possible alternatives considered when examining the lack of theoretical support was the nature of the categories of SES in this study.

There seems to be at least three possible discrepancies in the category system used in this study: (1) There was too much overlap of categories; (2) Environmental contamination was not well controlled; and (3) Educational opportunity deprivation associated with the lower SES level cannot be assumed.

There appears to be a tremendous overlap of all SES levels. In fact, any two of the three major categories have more commonality than uniqueness (Bronfenbrenner, 1958). In other words if the population curves of any two of the three SES levels were superimposed, the overlapping area would include more than 50 percent of the total area represented. For this reason many attempts to categorize people within a certain SES level have often fallen short. Further, each dimension of society has its own set of values. For instance, the socioeconomic area of life was used for establishing categories for this study. Whether such dimensions as the political, religious, educational, and recreational can be disregarded is a moot question.

Environmental factors are another consideration discussed here. Because of environmental factors many of those who now qualify for Title I* assistnace have not always qualified; many are recent additions. Qualification for Title I assistance can be brought about by extenuating situational conditions. For instance, a student whose parents were typically upper-middle class would qualify for Title I assistance if his parents were killed in an accident. Likewise, in a divorce proceeding, if the court so decides the child can become a ward of the court, and immediately becomes eligible for Title I assistance. In fact, those who qualify for Title I assistance are recomputed at regular intervals and there is a great deal of fluctuation within the persons qualifying.

The third discrepancy in the category system of SES level could be that the assumption of educational opportunity deprivation associated with the lower socioeconomic levels may not be valid, or may not be measured by this test. This assumption of educational-opportunity deprivation may not cause a difference in the associative learning rate of Ss from different socioeconomic levels. It was stated earlier (Chapter I) that the 16-Picture PALT represented an attempt to develop an instrument which would be relatively free of prior learning experiences. It may be that the PALT is, in fact, free of prior learning experiences. The results of testing hypothesis 1 would certainly support this idea.

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*Title I student percentages were the criteria used to establish the SES levels.

As a result of all these factors one could say in summation that the socioeconomic status (SES) seems to be composed of many facets, and should be considered on as many of these facets as possible. It is entirely possible that Title I students have one or possibly more of the characteristics common to all lower socioeconomic levels. However, this probably should not be the sole dimension for consideration.

Misapplication of Theory

An assumption (number 3) was made regarding the isolation and measurement of associative learning. It seems apparent that associative learning is occurring in the setting used in this study; however, the 16-Picture PALT is predicated on a verbal response of the subject. In other words it has a stimulus-response (S-R) dimension. As a result, those students who made no response within five seconds were given an error. The assumption being that if the subject has learned, he can verbalize the material learned. This may not be a legitimate assumption since it rules out <u>any</u> learning except that which can be verbalized. In other words, if the subject cannot verbalize his response the experimenter (E) must assume he does not know the answer.

An assumption was made that the 16-Picture PALT is an adequate instrument to measure the associative learning rate of the individual. However, the results of this study indicate no differences between _S_s of different SES levels. This must _not_ be interpreted as meaning there is no difference in the associative learning rates of _S_s from the different SES levels. But, this is only one of the possible conclusions. Another is that the test is insensitive to the SES differences being projected. The third possible conclusion is that the effects of interaction dominate any SES differences. Interaction effects will be discussed first.

It is possible that a certain amount of interaction occurs in nearly any testing situation, and as the tester becomes more involved with the testee a comparable increase in interaction can be expected. As a result of this interaction many confounding variables, both verbal and nonverbal, intentional and unintentional, conscious and unconscious, enter into the learning situation. Merton (1948, p. 81) coined a term "self-fulfilling prophecy" which he defined as "one person's expectations about the behavior of another person actually being fulfilled by that person."

Rosenthal and Jacobsen (1968, p. 7) defined such an occurrence as "one person's expectation for another person's behavior unwittingly becoming a more accurate prediction simply for its having been made."

Such expectancy effects on behavior have been observed in a variety of situations: sports (Whyte, 1943); business and industry (Bavelas, 1965 as reported in Rosenthal and Jacobsen, 1968); medicine (Shapiro, 1960; Sheard, 1963; Cole, Rickels, and Uhlenhuth, 1964; Beecher, 1966); and even in international affairs (Allport, 1950).

In order to relate intellectual performance and learning to experimenter expectancies, Marwit and Marcia (1967) designed a study to determine whether the number of responses given by a subject to a series of ink-blot tests was a function of the examiners' expectancies or the subject's intellect. The results revealed that those examiners predicting greater response productivity obtained significantly more responses than did those predicting fewer responses ($P < .003$). Masling (1965) also found that experimenter expectations significantly influenced the _type_ of responses to ink blots ($P < .05$). There are many ways the testers could have influenced the data collected in this study even in an unintentional way. Not the least likely of these ways is by communicating their expectations to the subjects whom they tested.

Another variable which could have confounded the experiment is varying patterns of reinforcement of the different testers. There are several types of reinforcement both verbal and nonverbal. (For a cogent but comprehensive account of these see: Hall and Lindzey, 1957; Loree, 1965; Klausmeier and Goodwin, 1966.).

It is quite easy for the experimenter to create an unfavorable halo effect in the testing situation. In one report (Harlem Youth Opportunities Unlimited, Inc. (HARYOU), 1964), it was suggested that minority ethnic groups are especially likely to suffer by unfavorable halo effects in the teacher's evaluation. Cahen's (1966, as reported in Rosenthal and Jacobsen, 1968) experiment in which he tested whether false information about pupils' aptitudes would influence the teacher's scoring of the pupil's test papers, found that the allegedly brighter pupils were given the benefit of the doubt to a much greater degree than the allegedly duller pupils ($P < .01$).

If this practice occurred either positively or negatively by any of the testers, the fact that the Ss were randomly distributed over all testers and all grades would also distribute the biased effect evenly over all conditions. The end result would have little effect on the interactions of the tester and subject.

A third area of confounding could be cited as the inability to consistently regulate the rate of presentation. Recall that the rate of presentation was set at one card every 3 seconds for the pairs in Booklet One and one card every 5 seconds for Booklet Two. However, it may be overloading the tester to have him manipulate a stopwatch, score sheet, pencil, two different booklets, and give directions. For this reason it is entirely possible that many of the Ss may have been unintentionally "short changed" on the amount of time they were exposed to the stimulus card. Underwood (1966) found that a discrepancy of ¼ of a second caused a significant difference in the learning rate of two sets of Ss.

There are possibly other confounding factors one could discuss; however, to do so would seem redundant. Suffice it to say that because of the highly active role of a tester in the experimental situation, to experience a confounding effect is not only possible--it is probable. If such a situation occurs the result is usually recorded as a significant interaction effect--this is exactly what was found in this study. This interaction was so significant it could easily have eliminated subtle differences between the SES levels.

This brings the discussion to the third possible explanation of the failure to reject the null hypotheses of the main effect of SES.

Improper Judgments and Evaluations

A decision based on faulty measurement would be invalid. Often improper judgments are made because of poor statistical procedures or invalid and unreliable instruments.

Certainly the possibility of a Type I error cannot be eliminated. However, it seems unlikely that two Type I errors could be committed in the same experiment on two ANOVAs. Further, the fact that the two resultant tables from the ANOVA of trials and errors are so similar would indicate a Type I error was improbable.

A review of the standardization procedures of the 16-Picture PALT failed to show it has ever been administered in a laboratory-like setting in an attempt to measure the associative learning rates of Ss *without* the experimenter effects of different reinforcement schedules, presentation schedules, etc. Because of these and other confounding factors, it is inevitable that a certain amount of the measures taken can be accredited to "us" (the tester and subject) not simply to "him" (the subject). It appears possible that the 16-Picture PALT may be too sensitive to interaction and not sensitive enough to differences between Ss of different SES levels.

The Duncan's Range Test on the trials and errors scores resulted in significant differences in the patterns of means for grade levels, and different testers, but not in the patterns of means for different SES levels.

The main effect of SES level showed no significant difference; however, the interaction of this variable with other independent variables was significant in every case. This suggests an interaction that makes a significant difference in the calculation of trials and errors of the subjects being tested.

Relationship of the Results to Previous Research

The findings of no significant difference between the different SES levels bears a close resemblance to the findings of Semler and Iscoe (1963). However, the categories used in their study were called "race" not socioeconomic status. No significance in SES levels supports the studies of Rohwer (1966) whose study involved lower- and middle-class Negroes, Jensen (1961) using Mexican-American and Anglo-American subjects, and Rapier (1966) who conducted a study based on the associative-learning rates of lower- and middle-class Caucasians. However, this study fails to support the study conducted by Purdy (1968) in which he used the 16-Picture PALT to compare the learning rates of Indians and Whites. Purdy found that sixth-grade Indians learned the 16-Picture PALT with significantly fewer trials than their White counterparts.

CHAPTER V

SUMMARY

One hundred and eighty _S_s of the second, fourth and sixth grades of the Oklahoma City Public School System were administered the _Stanford-Binet Individual Intelligence Scale_ to establish a category of normal (90-110) intelligence.

The schools were divided into three major SES categories: Lower-White, Lower-Black, and Higher-White. These categories were established by using the criteria of race and socioeconomic status. One school was chosen randomly from each of the SES categories. From each of these schools 60 _S_s of normal intelligence were chosen randomly for the study. The 60 _S_s of each school were assigned randomly to four testers. These testers administered the _16-Picture Paired-Associate Learning Task_ (PALT) to each of their subjects. A "trials" score and "errors" score was recorded for each _S_.

It had been hypothesized that no differences would occur as a result of measures recorded for _S_s of different socioeconomic (SES) level, grade level (2-4-6), testers, or interaction as a result of any combination of the three.

After a preliminary test of F_{max} revealed that neither the trial measure nor the error measure failed to meet the assumption of homogeneity of variance, a 3 x 3 x 4 analysis of variance (ANOVA) was performed, first on the trials scores and then on the errors scores. Both showed that one of the three main-effect variables (SES) was not significantly different from chance (i.e., the null hypotheses could not be rejected). However, the variables of grade level and testers, as well as all primary and secondary interactions were significant. A further analysis was made using the Duncan's Range Test in an attempt to locate specific mean differences. The DRT showed 47 group differences for the trials scores and 100 group differences for the errors scores. A Chi Square test was performed on the patterns of group differences. This test disclosed significant differences between the grade levels and testers, but not SES levels.

In essence the statistical analysis revealed that only the main effect of SES did not make a significant difference in the number of trials and errors recorded for the 180 _Ss_. Further, all interactions were significant.

In the discussion section, three approaches were taken to explain the reason for nonrejection of the null hypotheses concerning SES levels. These approaches were: (1) the theory was inaccurate, (2) misapplication of theory, and (3) improper judgments and evaluations. Each of these was discussed in detail. A final summation of the three was intended to stress the possible confounding effect of the 16-Picture PALT being administered by individuals who were aware of the SES, grade, and race of subjects they were testing. Stress was given to such concepts as experimenter bias, incidental learning, reinforcement schedules, reinforcement types (verbal and non-verbal), negative halo-effect, self-fulfilling prophecy, and latency of response.

The discussion emphasized the idea that the PALT may be too sensitive to interaction and that this could have caused it to miss subtle differences between SES levels. It was suggested that the administration of the PALT be more rigidly controlled.

Implications for Further Research

It seems apparent the 16-Picture PALT* needs to be given under conditions that will help eliminate these factors: (1) time discrepancy in the rate of presentation of stimulus pictures, (2) time discrepancy in scoring of errors, (3) instruction discrepancies, (4) discrepancies relating to reinforcement rates and methods, and (5) "unconscious" discrepancies caused by personal biases on the part of the tester toward (a) schools of a

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*See Appendix H concerning the reliability and validity of the 16-Picture PALT.

particular system, (b) a particular SES student, (c) a particular grade level, or age student, etc.

In other words, the test needs to be given in a more laboratory-like atmosphere.

There is a recent innovation in the educational field which would adapt well to the task of presenting paired-associate material in a well-regulated, objective, concise manner and yet retain the dynamic atmosphere of the classroom--that of Computer Assisted Instruction (CAI).

CAI would allow not only a more objective method of presentation and scoring of material, but would allow the testing of multiple subjects concurrently, while minimizing interaction. One of the problems in previous experiments has been the time and/or cost factors in the administration of the 16-Picture PALT. With CAI massive testing could be done under more "controlled" conditions.

Research in the future using the 16-Picture PALT could be set up with the stimulus and response pictures being presented by a mechanically-controlled drum. A possibility would be a memory drum of the type used to present nonsense syllables in testing serial learning. The choosing of items could be electronically controlled by having Ss push buttons to match the stimulus picture. This would eliminate the human element in the presentation and scoring procedure.

Another possible area open to study would be to use adult Ss instead of immature students. Because of the near cyclothymic shift of the child's personality, much of the data collected on the learning processes of children may be tainted with affect. A study of more mature adults using paired-associate lists of varying length could give some relevant information about associative learning.

One other area is an extention of the present study to include the higher-black SES. It would be interesting to see if the findings of no significant differences between lower SES blacks and lower SES whites would be found between higher SES blacks and higher SES whites. Findings from such a study may contribute to a better understanding of the influence of SES differences on the learning rates of both black and white students.

A final, and perhaps most important area of further research is in the development of an adequate instrument for measuring associative learning rates. Task variables, particularly meaningfulness and intralist similarity, seem to have powerful effects on learning rate. Meaningfulness of material appears to have a greater effect on the response items than on the stimulus items. At any rate, further research is certainly in order.

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APPENDIX A

Application to Conduct Research Within the Oklahoma City Public School System

Submit 4 copies to: Department of Research and Statistics
900 North Klein
Oklahoma City, Oklahoma 73106

RESEARCH APPLICATION TO OKLAHOMA CITY PUBLIC SCHOOLS

ABSTRACT

Applicant's Name: JIMMIE L. V. PRICKETT University: University of Oklahoma

Address: 1219 East Boyd, Norman, Oklahoma Telephone Number 364-1132 Degree Program Ed. D.

Advisor's Signature: P. T. T. [signature] Department: Special Education

TITLE: Associative Learning Rates of Selected Second, Fourth, and Sixth Grade Normal Black and Normal White Students With Cultural Differences Using a Paired-Associate Learning Task

OBJECTIVES: To study the learning rates of normal 2nd, 4th and 6th grade students with a cultural difference.

PROCEDURE: (General Design, Population and Sample, Instrumentation, Analysis, Time Schedule, etc.)

60 culturally favored white, 60 culturally deprived white and 60 culturally deprived black students will be selected for the study. Parental permission will be obtained by the researcher before any student is included in the study. The total involvement for each student will be approximately 35 minutes. * The abbreviated form of the Stanford-Binet will be administered followed by a culture fair task which includes simple, common objects such as: comb, chair, brush, tree, bread, sun, fish, coat and kite. This task was first used in the Oklahoma City Public Schools about 10 years ago by Dr. Gladys Hiner.

The researcher will work closely under the supervision of the building principals and make every effort to not interfere with the on-going school activities.

It is anticipated that the study will take approximately three weeks to be completed. Any resultant information will be available to the Oklahoma City Public Schools.

*NOTE: Before testing, it was decided the complete Stanford-Binet Intelligence Scale, Form L-M would be used. This increased the testing time for each subject to approximately one hour and 15 minutes.

INVOLVEMENT OF OKLAHOMA CITY SCHOOLS: (Use back of sheet, if necessary)

The Oklahoma City Schools will be asked to help identify the areas from which the students are to be selected. Hopefully, existing standardized test information will be made available by the schools for discriminate use by the researcher. It is anticipated only three elementary schools will be involved in the study.

All applications will be reviewed by a Research Committee. You will be notified by mail as to the decision of the committee. This process will usually take about two weeks.

APPENDIX B

Letter of Approval to Conduct Research Within The Oklahoma City Public School System

Oklahoma City Public Schools
900 North Klein
Oklahoma City, Oklahoma 73106

October 27, 1969

Mr. Jimmie L. V. Prickett
1219 East Boyd
Norman, Oklahoma

Dear Mr. Prickett:

The Research Committee has approved your request to conduct research in the Oklahoma City Public Schools according to the application you recently submitted.

We request that you coordinate the activities in connection with the study with Dr. Frances Peters, Consultant-Testing Evaluation.

We would appreciate receiving a copy of the completed study for our files.

Sincerely yours,

William L. Shell

William L. Shell
Director
Research and Statistics

WLS/ys

CC: Dr. Frances Peters

APPENDIX C

Individual Record Sheet for Scoring the 16-Picture Paired-Associate Learning Task (PALT)

APPENDIX C

INDIVIDUAL RECORD SHEET

Name:____________________ Grade Level:______________

Age:____________________ School:______________

Examiner:____________________ Date:______________

PAIRS

TRIALS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1																
2																
3																
4																
5																
6																
7																
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APPENDIX D

Raw Scores of Lower-White Subjects

RAW SCORES

SECOND-GRADE LOWER-WHITE SUBJECTS

Subject	Tester	CA	IQ	Trials	Errors
1	AV	88	94	11	73
2	AV	91	104	3	14
3	AV	96	106	9	48
4	AV	89	98	6	38
5	AV	93	102	8	40
6	LH	88	96	11	58
7	LH	90	104	6	22
8	LH	96	106	23	145
9	LH	87	98	7	36
10	LH	87	110	11	65
11	ND	89	101	13	96
12	ND	91	90	11	71
13	ND	93	106	6	40
14	ND	95	91	14	95
15	ND	96	104	11	76
16	RR	93	93	9	42
17	RR	95	99	11	57
18	RR	93	102	8	46
19	RR	95	106	7	43
20	RR	92	92	18	150
Means		91.75	100.10	10.15	62.75

RAW SCORES

FOURTH-GRADE LOWER-WHITE SUBJECTS

Subject	Tester	CA	IQ	Trials	Errors
1	LH	112	90	10	70
2	LH	114	92	9	57
3	LH	114	106	4	17
4	LH	113	90	9	68
5	LH	109	91	6	16
6	RR	110	103	7	35
7	RR	124	99	6	32
8	RR	110	110	9	48
9	RR	113	91	8	42
10	RR	111	95	8	32
11	ND	109	105	10	73
12	ND	109	98	11	61
13	ND	110	106	6	38
14	ND	127	91	7	30
15	ND	119	92	6	28
16	AV	111	98	4	15
17	AV	112	103	5	10
18	AV	111	107	8	39
19	AV	111	98	6	27
20	AV	114	101	6	25
Means		113.15	98.30	7.25	38.15

RAW SCORES

SIXTH-GRADE LOWER-WHITE SUBJECTS

Subject	Tester	CA	IQ	Trials	Errors
1	LH	146	100	3	19
2	LH	145	97	5	23
3	LH	139	104	7	34
4	LH	147	91	12	75
5	LH	146	91	8	56
6	RR	146	94	8	42
7	RR	132	106	4	18
8	RR	139	91	12	77
9	RR	141	99	9	48
10	RR	143	103	6	24
11	ND	139	95	7	47
12	ND	144	99	4	23
13	ND	144	100	4	17
14	ND	155	100	3	15
15	ND	134	91	17	109
16	AV	138	94	6	32
17	AV	155	95	5	25
18	AV	138	100	5	30
19	AV	138	109	8	42
20	AV	144	104	7	41
Means		142.65	98.15	7.00	39.85

APPENDIX E

Raw Scores of Higher-White Subjects

RAW SCORES

SECOND-GRADE HIGHER-WHITE SUBJECTS

Subject	Tester	CA	IQ	Trials	Errors
1	LH	91	95	12	53
2	LH	96	106	9	43
3	LH	88	96	6	42
4	LH	94	109	10	54
5	LH	90	108	14	74
6	RR	90	92	9	45
7	RR	91	100	19	80
8	RR	95	99	5	18
9	RR	97	95	10	38
10	RR	91	95	7	24
11	ND	86	106	22	155
12	ND	86	109	4	23
13	ND	92	103	10	52
14	ND	93	95	13	90
15	ND	94	109	10	63
16	AV	89	109	6	31
17	AV	94	100	7	42
18	AV	90	99	8	61
19	AV	86	109	4	8
20	AV	93	97	12	89
Means		91.30	101.55	9.85	54.25

RAW SCORES

FOURTH-GRADE HIGHER-WHITE SUBJECTS

Subject	Tester	CA	IQ	Trials	Errors
1	LH	116	109	6	26
2	LH	111	107	7	26
3	LH	116	106	8	38
4	LH	119	109	7	54
5	LH	114	109	6	24
6	RR	111	110	6	30
7	RR	120	105	4	16
8	RR	111	100	7	41
9	RR	114	102	5	18
10	RR	117	98	5	20
11	ND	112	94	8	44
12	ND	116	92	9	50
13	ND	114	91	11	69
14	ND	114	99	9	56
15	ND	119	93	22	126
16	AV	112	97	5	18
17	AV	114	96	6	35
18	AV	116	101	6	27
19	AV	116	94	13	87
20	AV	115	96	4	25
Means		114.85	100.40	7.70	41.50

RAW SCORES

SIXTH-GRADE HIGHER-WHITE SUBJECTS

Subject	Tester	CA	IQ	Trials	Errors
1	LH	136	109	5	17
2	LH	133	108	4	17
3	LH	143	104	4	13
4	LH	145	103	6	35
5	LH	144	107	6	28
6	RR	141	107	4	15
7	RR	136	100	7	47
8	RR	141	98	8	41
9	RR	144	99	5	32
10	RR	139	102	8	26
11	ND	139	100	7	26
12	ND	145	103	6	14
13	ND	146	90	5	21
14	ND	147	92	7	28
15	ND	136	104	7	31
16	AV	138	96	6	27
17	AV	143	92	7	31
18	AV	136	97	4	20
19	AV	147	97	3	8
20	AV	139	95	6	37
Means		140.90	100.15	5.75	25.70

APPENDIX F

Raw Scores for Lower-Black Students

RAW SCORES

SECOND-GRADE LOWER-BLACK SUBJECTS

Subject	Tester	CA	IQ	Trials	Errors
1	LH	91	109	11	61
2	LH	98	100	16	109
3	LH	88	99	12	80
4	LH	93	99	13	68
5	LH	97	105	10	58
6	RR	95	93	7	45
7	RR	96	92	9	41
8	RR	93	91	7	10
9	RR	88	99	11	59
10	RR	98	98	6	39
11	ND	88	92	13	64
12	ND	92	98	7	24
13	ND	97	110	6	38
14	ND	89	96	14	88
15	ND	91	90	18	120
16	AV	90	94	10	65
17	AV	91	93	8	40
18	AV	94	103	4	30
19	AV	88	106	4	17
20	AV	95	106	6	36
Means		92.60	98.65	9.60	54.60

RAW SCORES

FOURTH-GRADE LOWER-BLACK SUBJECTS

Subject	Tester	CA	IQ	Trials	Errors
1	LH	118	101	10	70
2	LH	120	104	7	33
3	LH	116	101	5	21
4	LH	114	92	4	20
5	LH	106	92	6	32
6	RR	117	95	7	31
7	RR	123	92	9	21
8	RR	121	95	10	32
9	RR	121	103	5	15
10	RR	111	102	11	62
11	ND	112	105	6	25
12	ND	113	93	11	73
13	ND	112	99	4	14
14	ND	114	99	10	48
15	ND	118	100	11	74
16	AV	115	90	3	12
17	AV	114	97	5	31
18	AV	118	102	5	33
19	AV	115	90	3	5
20	AV	112	99	7	43
Means		115.50	97.55	6.95	34.75

RAW SCORES

SIXTH-GRADE LOWER-BLACK SUBJECTS

Subject	Tester	CA	IQ	Trials	Errors
1	LH	136	98	5	22
2	LH	143	100	5	19
3	LH	142	105	5	24
4	LH	142	101	7	47
5	LH	144	101	4	25
6	RR	140	98	5	25
7	RR	137	91	6	27
8	RR	138	93	9	56
9	RR	146	105	5	19
10	RR	152	90	4	23
11	ND	134	91	6	36
12	ND	136	101	6	35
13	ND	144	90	14	95
14	ND	139	106	14	75
15	ND	138	96	4	17
16	AV	134	94	15	94
17	AV	141	97	5	31
18	AV	133	107	5	20
19	AV	141	95	6	38
20	AV	140	105	7	40
Means		140.00	98.20	6.90	38.40

APPENDIX G

Means and Standard Deviations of the Number of Trials to Criterion

Means and Standard Deviations of the Number of Errors Recorded

TABLE 20

PATTERNS OF TRIALS TO CRITERION BY SES LEVEL

Trial Number	SES								
	Lower-White			Higher-White			Lower-Black		
	2*	4*	6*	2*	4*	6*	2*	4*	6*
1									
2									
3	1		2			1		2	
4		2	3	2	2	4	2	2	3
5		1	3	1	3	3		4	7
6	3	6	2	2	5	5	3	2	4
7	2	2	3	2	3	5	3	3	2
8	2	3	3	1	2	2	1		
9	2	3	1	2	2		1	1	1
10		2		4			2	3	
11	6	1			1		2	3	
12			2	2			1		
13	1			1	1		2		
14	1			1			1		2
15									1
16							1		
17			1						
18	1						1		
19				1					
20									
21									
22				1	1				
23	1								
24									
25									
Mean	10.1	7.25	7.00	9.85	7.70	5.75	9.60	6.95	6.90
s.d.	2.08	2.11	1.99	2.37	2.52	1.99	2.11	2.51	2.49

* 2 = second grade; 4 = fourth grade; 6 = sixth grade

TABLE 21

PATTERNS OF ERRORS RECORDED BY SES LEVEL

Error Number	SES								
	Lower-White			Higher-White			Lower-Black		
	2*	4*	6*	2	4	6	2	4	6
8-11		1		1		1	1	1	
12-14	1					2		2	
15-17		2	2		1	3	1	1	1
18-20		1	2	1	3	1		1	4
21-23	1		2	1		1		2	1
24-26		1	2	1	4	2	1	1	3
27-29		2			1	3			1
30-32		3	2	1	1	3	1	4	1
33-35		1	1		1	1		2	1
36-38	2	1		1	1	1	2		2
39-41	2	1	1		1	1	3		1
42-44	2	1	2	3	1			1	
45-47	1		1	1		1	1		1
48-50	1	1	1		1			1	
51-53				2					
54-56			1	1	2				1
57-59	2	1					2		
60-62		1		1			1	1	
63-65	1			1			2		
66-68		1					1		
69-71	1	1			1			1	
72-74	1	1		1				2	
75-77	1		2						1
78-80				1			1		
81-83									
84-86									
87-89				1	1		1		
90-92				1					
93-95	1								2
96-98	1								
99-101									
102-104									
105-107			1						
108-110							1		
111-113									
114-up	2			1	1		1		
Means	62.7	38.2	39.7	54.3	41.5	25.7	54.6	35.8	38.8
s.d.	28.1	18.4	23.3	32.0	26.5	9.9	28.1	18.3	24.1

* 2 = second grade; 4 = fourth grade; 6 = sixth grade

APPENDIX H

Validity and Reliability of the 16-Picture PALT

VALIDITY AND RELIABILITY OF THE 16-PICTURE PALT

Little space will be given to the usual distribution of items on an associative learning task which is presented serially. There are several good sources of information concerning the proper presentation of associative learning material. One of the best sources is given in a book called <u>Experimental Psychology</u> by B. J. Underwood (1966).

In essence, it has been established that the order of serial learning usually will ensue in the following pattern: the initial item will be learned first, the last item will be learned second, the second item will be learned third, the next-to-last item will be learned fourth, etc. This pattern of starting on either end and working toward the middle will continue until all the items are learned. Underwood states that the curve assumed by the items is extremely consistent and highly predictable. Therefore, if an item is continually learned "out of order" it would indicate the difficulty of the item is in question (e.g., if item number 6 is learned first every time on a 12 item list, there is good reason to believe that the item is too easy and should be altered or removed from the test).

Hiner (1968) relates the procedure used in her study which she believes was responsible for eliminating order effects. Hiner (p. 13) states:

> During the testing to determine test length, serial effects were noted in the learning curves of some groups. . . . It was known that if the learning curves could be flattened so that the end-pairs of the lists were not learned more quickly than the middle-pairs, the serial effects would be controlled and a random presentation of the lists would be unnecessary. Therefore, one hundred twelve students were then tested using various arrangements of the pairs until the learning curves became flat with certain arrangements. It was desired to keep the arrangement of the pairs constant, since certain random orders might be more difficult to learn than others; and an additional variable would then be introduced. A random presentation of pairs could not be kept constant from subject to subject since the subjects would vary with respect to the number of trials needed to reach the learning criterion.

The practice of "flattening" the serial effects curve by the manipulation of items is a questionable procedure.

Underwood (p. 491) states:

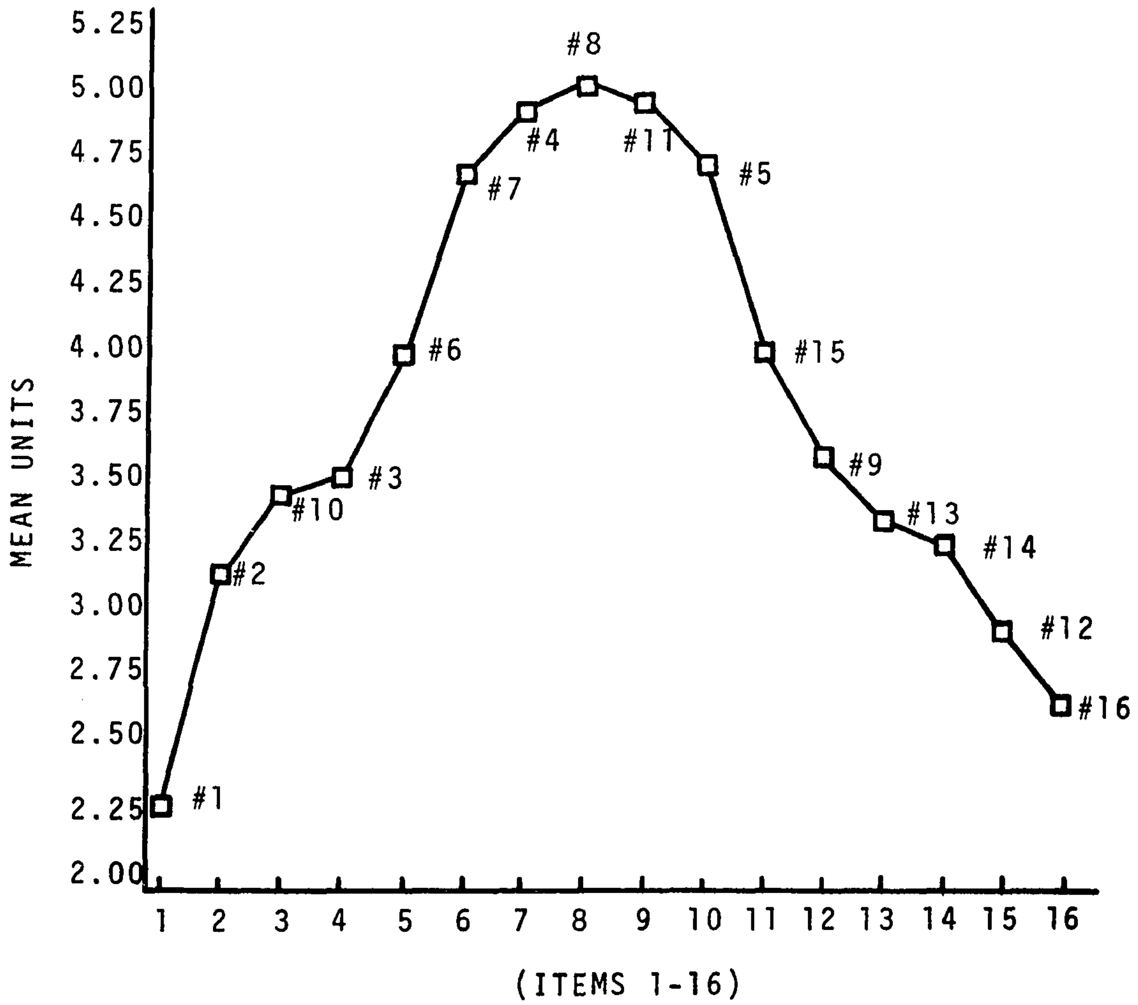
> In truth, it is extremely difficult to test hypotheses, about the bowed curve to serial learning because it is relatively invariant; it cannot be "pushed around" very much by manipulating other variables . . . to skew or attempt to eliminate the serial curve by manipulation of the items will only lead to a confounding effect since it will result in items of varying difficulty.

This would indicate that no attempt should be made to eliminate the serial-learning curve. In fact, if the items on a test which is presented serially are chosen correctly, correctly placed in the order of presentation, and correctly administered, the distribution of the mean-trials per item should approximate closely a serial-learning curve.

Using the items in the 16-Picture PALT as an example, an ideal distribution of the items is shown in Figure 12.

Figure 12

GRAPH OF THE MEAN-NUMBER
OF TRIALS PER ITEM 1-16
(IDEALLY DISTRIBUTED)



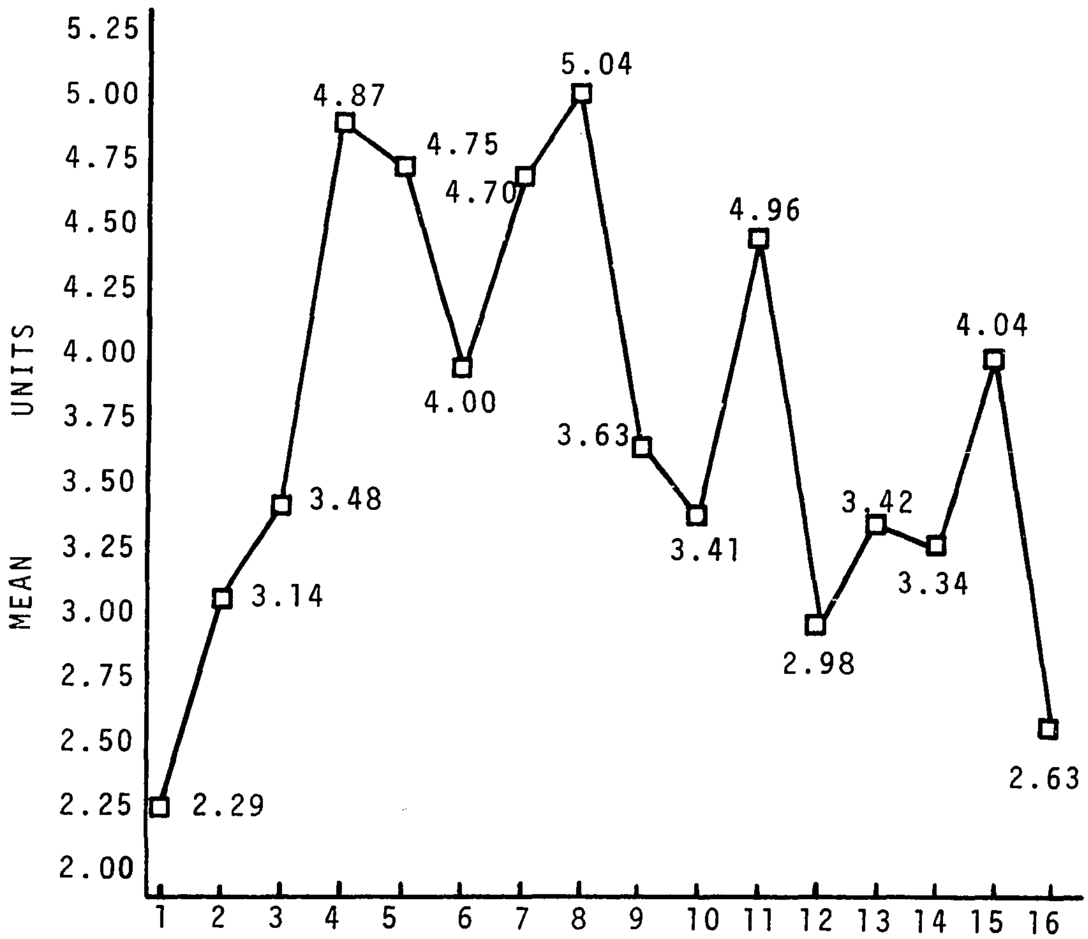
The actual distribution of the mean-trial scores is shown in Figure 13. This appears to indicate that several of the items need to be shifted to different positions in the order of presentation, or perhaps eliminated from the test completely. Items number 6, 9, 10, and 15 seem to be the most obvious.

As a further check on item placement, several graphs were plotted to determine whether the departure from the usual serial learning curve was in the test itself or one of the independent variables being manipulated. The first of these graphs is presented in Figure 14. It is a graph of the different SES levels and their mean-trials scores. Since each of the SESs tested assumed an almost identical pattern as the overall scores of all *S*s, seemingly it can be established that the discrepancy in the item placement is not caused by the different SESs.

Depicted in Figure 15 are the mean-trials per item of the three grade levels. Even though there are large differences between them, this is to be expected. This discrepancy merely indicates the difference in the mean-number of trials required for each grade to reach the learning criterion. In the case of grade level, the most important indication of uniformity is the degree to which the lines are *parallel*. Clearly it can be seen the lines of each grade do assume parallel positions in relation to each other. Therefore, the grades tested did not

Figure 13

GRAPH OF THE MEAN-NUMBER
OF TRIALS PER ITEM 1-16
(N=180)



(ITEMS 1-16)

ITEM NUMBER

	2.29	3.14	3.48	4.87	4.75	4.00	4.70	5.04
Trials	1	2	3	4	5	6	7	8
	3.63	3.41	4.96	2.98	3.42	3.34	4.04	2.63
	9	10	11	12	13	14	15	16

Figure 14

GRAPH OF THE MEAN-NUMBER OF
TRIALS PER ITEM BY SES

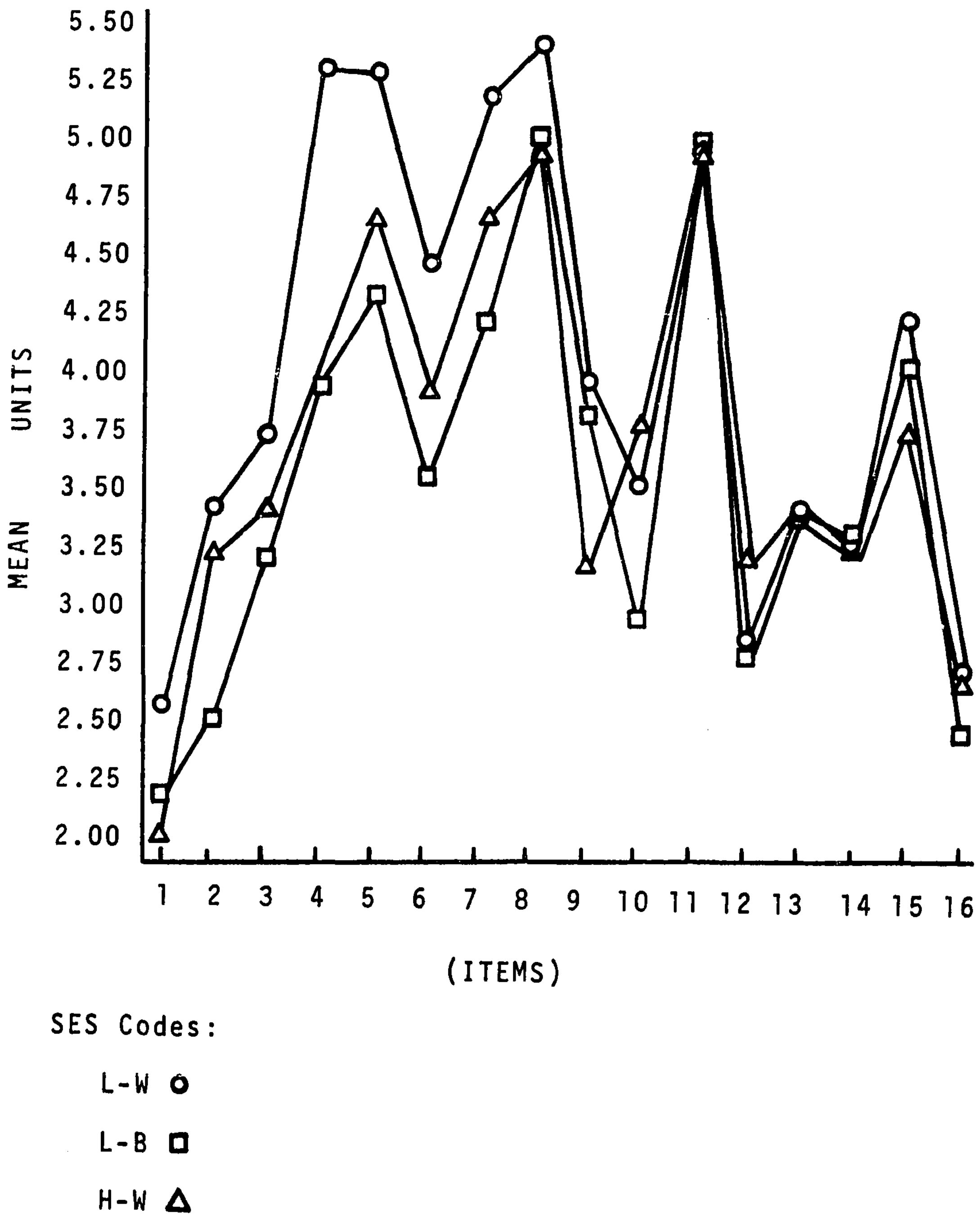
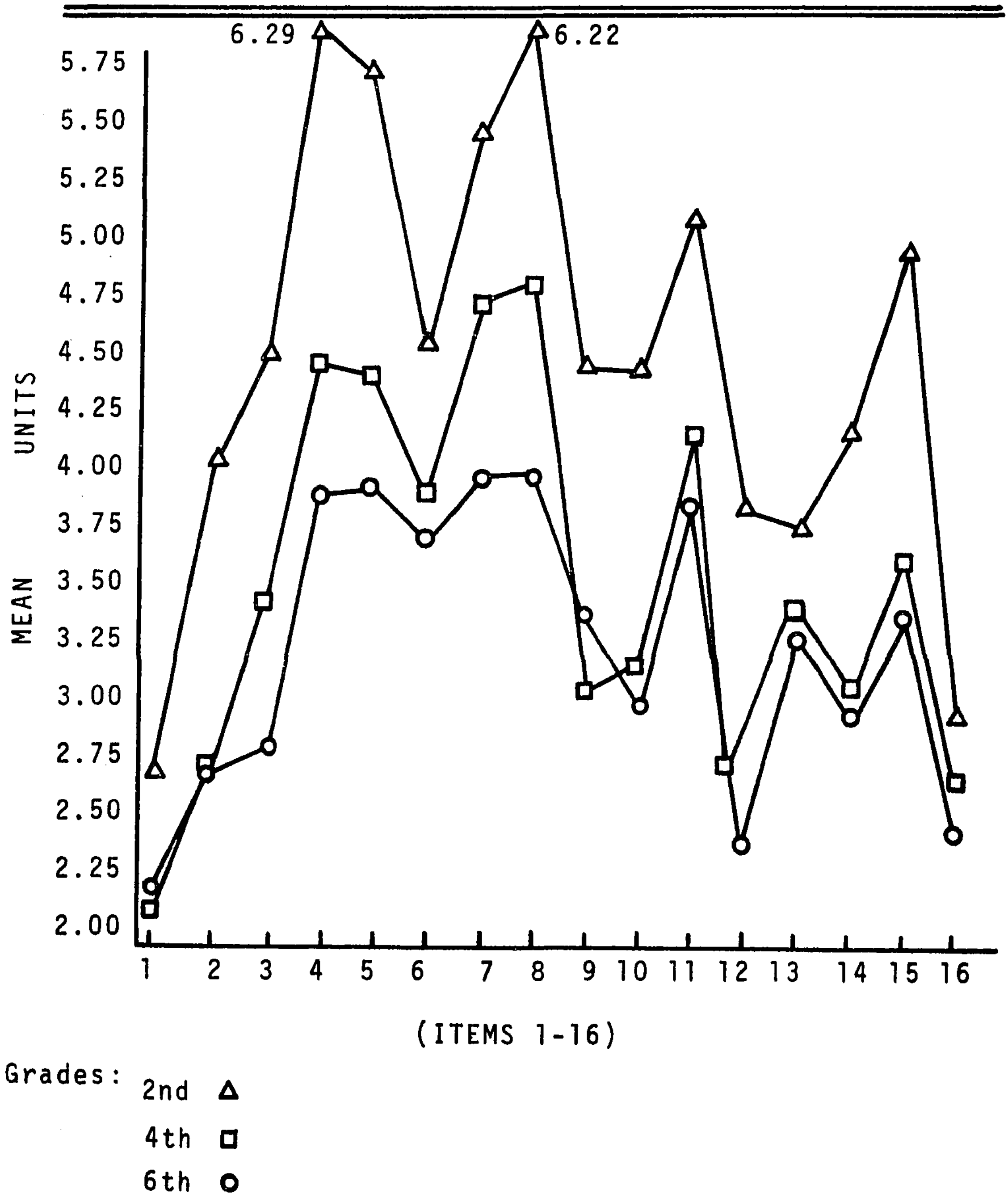


Figure 15

GRAPH OF THE MEAN-NUMBER OF
TRIALS PER ITEM BY GRADES



make a significant contribution to the displacement of items.

Figure 16 is a graph of the third independent variable manipulated in the experiment--testers. Even though the Ss tested by RR usually required more trials than those Ss tested by the other three testers, and Ss tested by AV usually required fewer trials than those Ss tested by the other three testers, the distribution of the mean-trials scores seems to indicate the testers did not contribute to item displacement.

Figure 17 represents a final attempt to account for the discrepancy of item placement. Exhibited is the distribution of mean-trials scores by sex. In general, the males required more trials than the females on each item. This is especially obvious with items 4, 5, 7, and 9. A close inspection of these items as presented in Appendix J shows three of them (Items 5, 7, and 9) to be "female oriented," (e.g., the stimulus items were items usually associated with domestic tasks relegated to females in the American culture). This orientation toward one sex could easily account for the differences in trials to criterion.

In summation it can be said the 16-Picture Paired-Associate Learning Task (PALT) needs further revision and application. However, after the items have been changed, it must not be assumed the 16-Picture PALT is ready for

Figure 16

GRAPH OF THE MEAN-NUMBER OF TRIALS PER ITEM BY TESTER

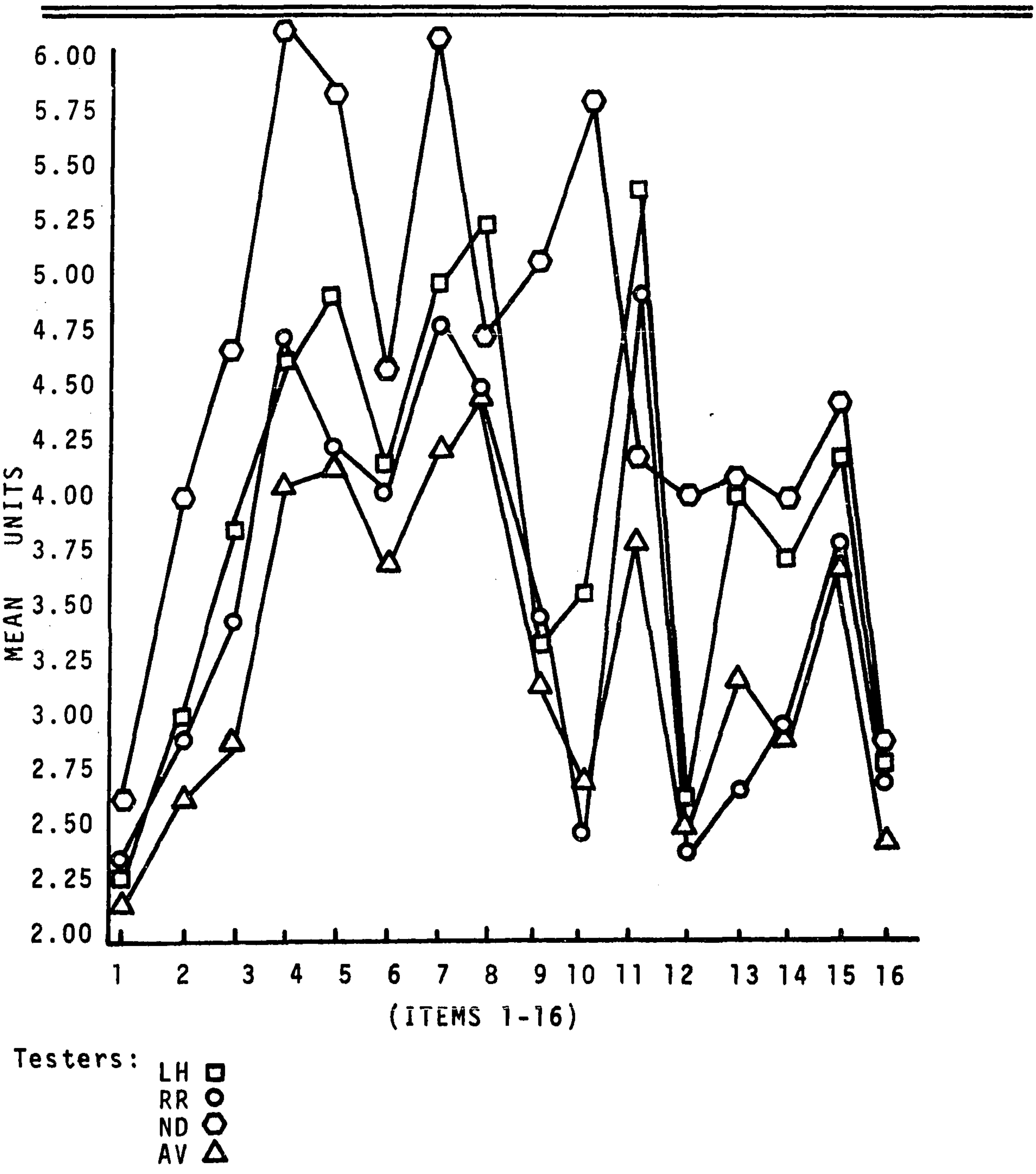
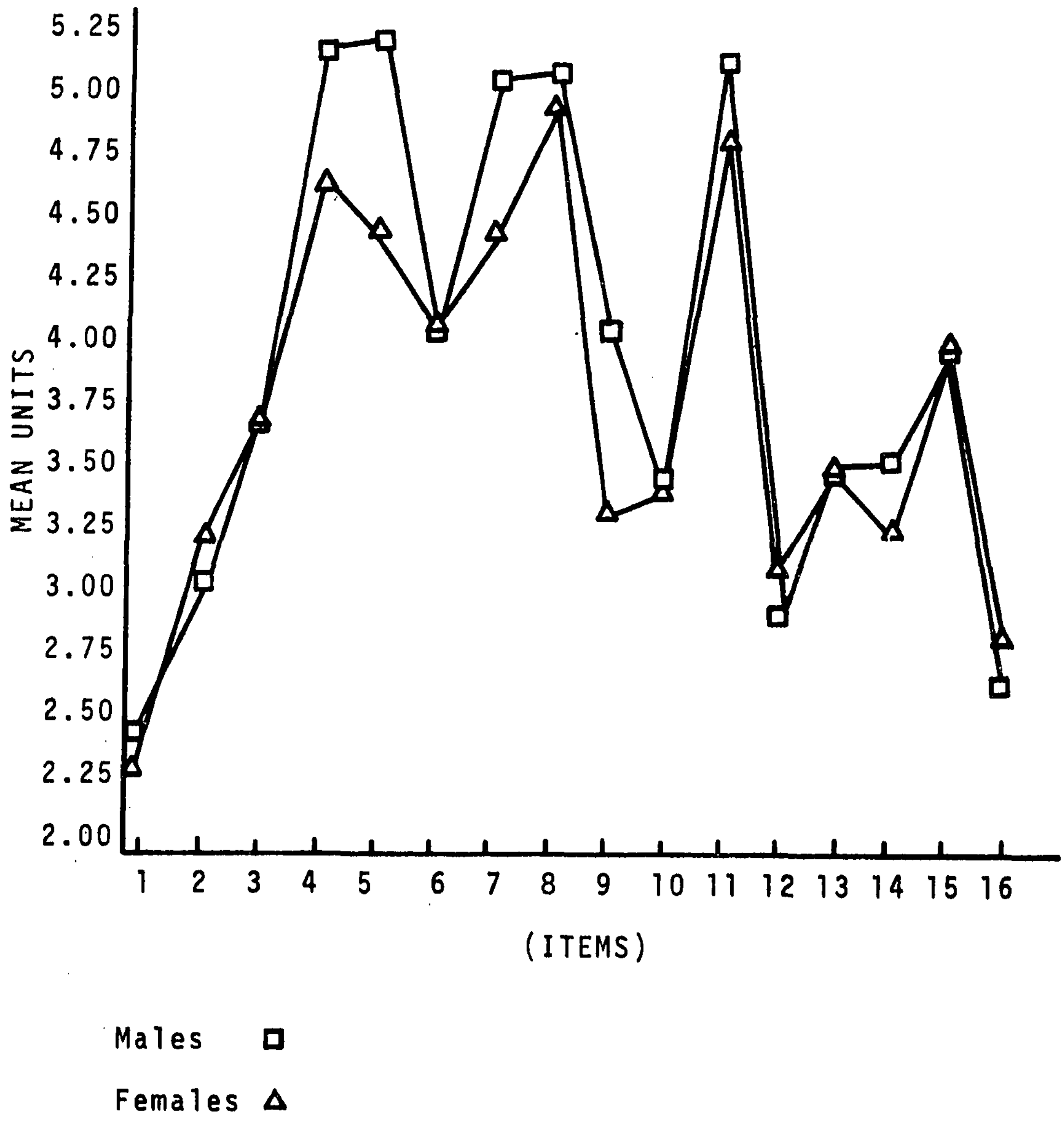


Figure 17

GRAPH OF THE MEAN-NUMBER OF
TRIALS PER ITEM BY SEX



use with any or all populations. Because of the unique nature of each population tested, it seems imperative that a pilot study be run to determine the proper order of the items to be used in the study.

Test Reliability

Although some statistical analysis has been done on the validity and reliability of the 16-Picture PALT, a perusal of the literature failed to yield any validation procedures. The reliability of the 16 items is presented in Table 22. The internal-consistency measure of the 16-Picture PALT was computed using the *Kuder-Richardson Formula 8* (Kuder & Richardson, 1937) for estimating test reliability from the variance of the total scores and the sum of the item variances.

Test Validity

The concurrent validity of the 16-Picture PALT was calculated using the Stanford-Binet IQ scores as the external criterion and the number of trials recorded for the *S* as the predictor. The concurrent validity was calculated to be *.4123* (Winer, 1962).

TABLE 22

RELIABILITY OF THE 16-PICTURE PALT ESTIMATED
BY INTERNAL CONSISTENCY COEFFICIENTS

Items	Internal Consistency Coefficients (N = 180)		
	Item-Test Correlation	Mean	s.d.
1	.72	2.29	.82
2	.87	3.14	1.02
3	.74	3.48	.96
4	.71	4.87	1.37
5	.69	4.75	.83
6	.86	4.00	1.27
7	.91	4.70	1.06
8	.73	5.04	1.53
9	.56	3.63	.94
10	.79	3.41	.78
11	.77	4.96	1.29
12	.92	2.98	.71
13	.94	3.42	.98
14	.61	3.34	.89
15	.67	4.04	1.21
16	.53	2.63	.64

APPENDIX I

Glassman-Millman Technique for Estimating Mean Squares

The formation of the appropriate _F_ ratios in the 3-way analysis of variance used in this study was accomplished by using a technique called the _Glassman-Millman Technique for Estimating Mean Squares_ (Glassman & Millman, 1940). The _F_ ratios to be formed are placed on both sides of a matrix as shown in Figure 18. The first column is headed with variance since all the sums of squares contain variance. The second column is headed with a letter representing the first independent variable, the third column is headed by a letter representing the second independent variable, etc. The variables and interactions are then placed in the rows as shown in Figure 18. Starting with row _A_ move through all the columns with row _A_ from the variance to ABC. As the variable _A_ is moved from column to column, two questions must be asked: 1) Does the column heading have at _least_ the mean square I am trying to estimate? and 2) Is there more in the column heading than I am trying to estimate? If there is, a third question must be answered. 3) Are the extra variables random or fixed? If they are random, they stay as one piece of the m.s. approximation. If they are fixed, they are omitted from the matrix. For instance _A_ is represented in the column heading of _AB_, but _B_ is fixed so it is omitted from the matrix. This same procedure is followed for each of the variables being considered.

The resultant _F_ ratios are given in Figure 19.

Figure 18

GLASSMAN-MILLMAN TECHNIQUE OF
ESTIMATING MEAN SQUARES
OF A FIXED MODEL

	σ_e^2	A	B	C	AB	AC	BC	ABC
A	X	X						
B	X		X					
C	X			X				
AB	X				X			
AC	X					X		
BC	X						X	
ABC	X							X
σ_e^2	X							

<u>Variables</u>:

A = Fixed
B = Fixed
C = Fixed

These can be applied to the data tabled on each of the ANOVAs performed.

Figure 19

F RATIOS FORMED BY THE GLASSMAN-MILLMAN TECHNIQUE

$$F_A = \frac{\sigma_e^2 + A}{\sigma_e^2}$$

$$F_B = \frac{\sigma_e^2 + B}{\sigma_e^2}$$

$$F_C = \frac{\sigma_e^2 + C}{\sigma_e^2}$$

$$F_{AB} = \frac{\sigma_e^2 + AB}{\sigma_e^2}$$

$$F_{AC} = \frac{\sigma_e^2 + AC}{\sigma_e^2}$$

$$F_{BC} = \frac{\sigma_e^2 + BC}{\sigma_e^2}$$

$$F_{ABC} = \frac{\sigma_e^2 + ABC}{\sigma_e^2}$$

APPENDIX J

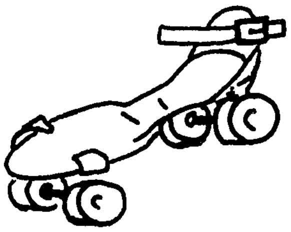
The 16-Picture PALT

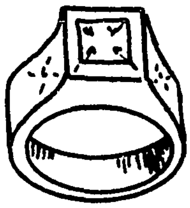
The 16-Picture PALT

The 16 pairs of associates used in this study are displayed on the following pages. Even though 17 pairs are presented, PAIR X is a practice card. The 16 pairs are the actual pairs and are in the exact order used in the experiment. Little comment has been made about the similarity of pairs or the meaningfulness of the stimulus or the response pictures. However, it can be seen such pairs as COMB-DRUM (Number 7) have similar phonetical pronunciations. This should make an easy association, while such pairs as HAT-CUP (Number 8) may have little meaningfulness to students who are very young. Such discrepancies as these need further investigation.

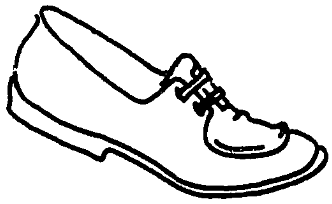
Figure 20

Sample Pair X

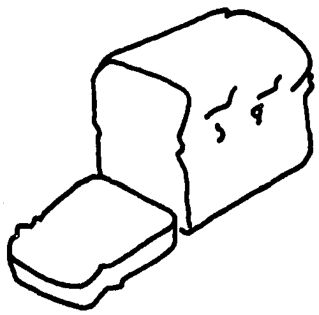


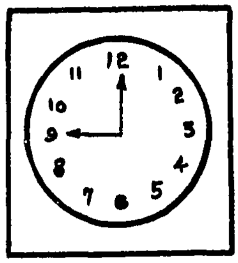


PAIR 1

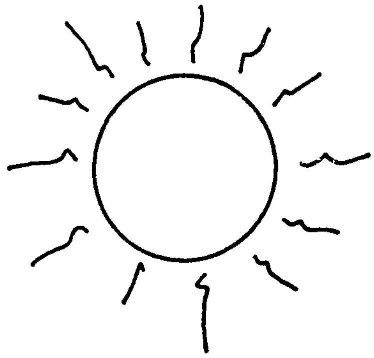


PAIR 2

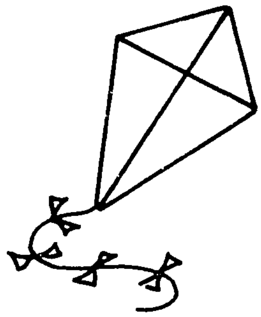


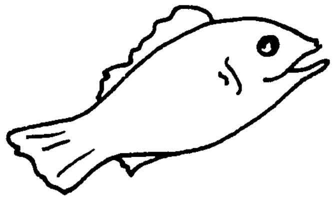


PAIR 3

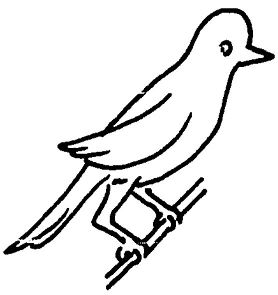


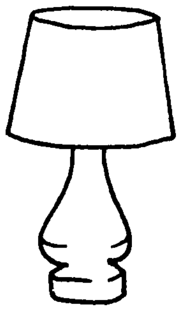
PAIR 4



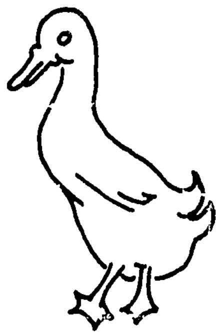


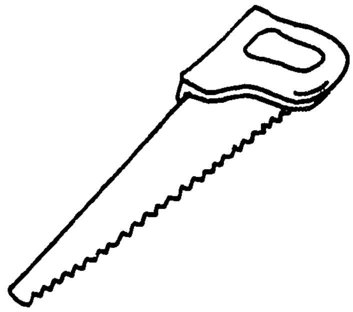
PAIR 5



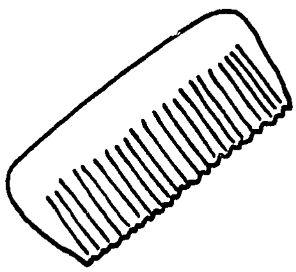


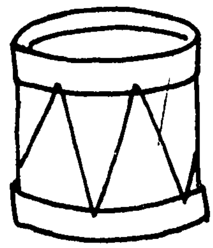
PAIR 6



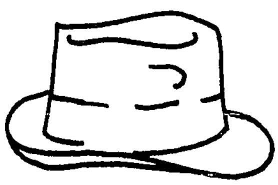


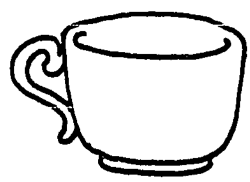
PAIR 7



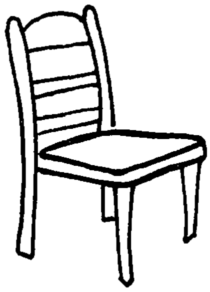


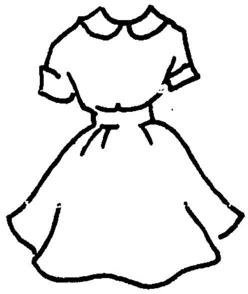
PAIR 8



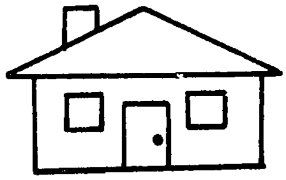


PAIR 9

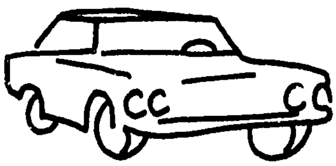


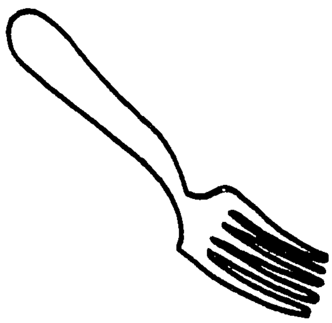


PAIR 10

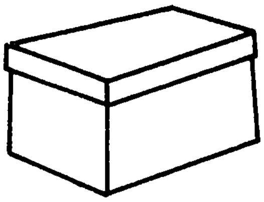


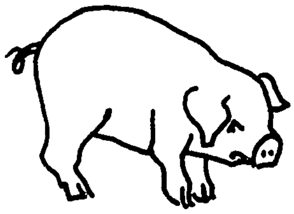
PAIR 11



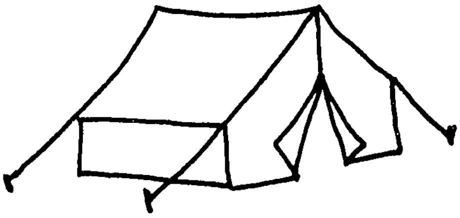


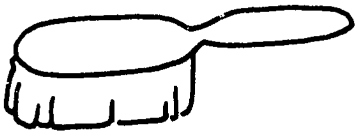
PAIR 12



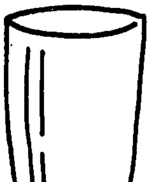


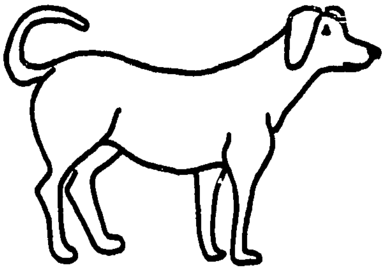
PAIR 13



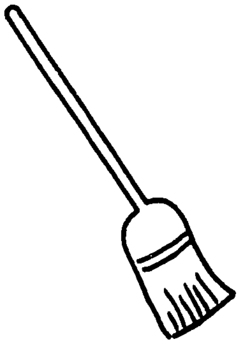


PAIR 14

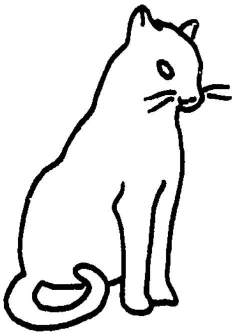


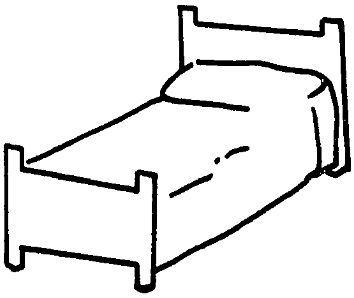


PAIR 15



PAIR 16





APPENDIX K

Raw Data Used in Calculation of Validity and Reliability of the 16-Picture PALT

<u>Raw Data Used in Calculation of Validity and Reliability of the 16-Picture PALT</u>. The raw data presented in Table 23 are those used in calculating the validity and reliability of the PALT. The format used in keypunching the data is disclosed in Figure 21.

Figure 21

CARD FORMAT USED IN KEYPUNCHING THE DATA FOR THE RELIABILITY AND VALIDITY CHECK*

Column(s)	Information
1-3	Number of the Subject (001-180)
4	Sex of the Subject (1 = male, 2 = female)
5	Grade Level of <u>S</u>s (2, 4, and 6)
6-9	Age of <u>S</u>s in years and months
10	School(1 = L-W,SES; 2 = L-B,SES; 3 = H-W,SES
11	Tester(1 = LH, 2 = RR, 3 = ND, 4 = AV)
12-13	Number of Trials Needed to Learn Item Number 1
14-15	" " " " " " " " 2
16-17	" " " " " " " " 3
18-19	" " " " " " " " 4
20-21	" " " " " " " " 5
22-23	" " " " " " " " 6
24-25	" " " " " " " " 7
26-27	" " " " " " " " 8
28-29	" " " " " " " " 9
30-31	" " " " " " " " 10
32-33	" " " " " " " " 11
34-35	" " " " " " " " 12
36-37	" " " " " " " " 13
38-39	" " " " " " " " 14
40-41	" " " " " " " " 15
42-43	" " " " " " " " 16
44-45	Number of Trials Needed to Learn the PALT
46-48	Number of Errors Committed by the <u>S</u>

*One card per subject

The total information for each subject was contained on one card. This made a total of 180 cards. The original computer printout was used as an attempt to conserve effort and eliminate the possibility of human error in the reproduction of the data (Table 23).

TABLE 23

Table 23 RAW DATA OF THE 180 SUBJECTS CONCERNING TRIALS TO CRITERION BY ITEM

001120704140206031107030409060302070807090511073
002120707140202020302010303020101020201020103014
003220800140403060803090208040602020205020109048
004220705140303030502020104040103040505060406038
005220709140104070208040306010103070202060108040
006220705110405040805020311070109020103060411058
007120706110101010303010106010205010504030106022
008120810110404232014032115020916031506180423145
009120703110302020604070304010206050301030507036
010220703110301081004040707050611030404040211065
011120705130405050913120608111111020202050713096
012220706130108030710051109080605020303030211071
013120709130405050203060403020204030302060406040
014240711130406120914040309060708081104010214095
015120800130609041106040408030903050210100211076
016220709120104060303040407050208030202020209042
017220711120302090906051104040407030203010111057
018120709120107030807040305040105020303050108046
019220711120102030204070506030407030203070207043
020220706121010111513171106170318080408111118150
021240904110205040209050907040809021006030710070
022240906110104020303050308070908020803060309057
023140906110301020104020403010202010304010104017
024140900110404080808090905050201020307070209068
025140900110201020206020301010101010103030206016
026240902120102040403020703020204010603040207035
027241004120302030305030506020504030102040306032
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031240901130405040604030610050307060807070510073
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039140903140202020202030406010203010202060106027
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042261201110203040304020102050102020203030205023
043161100110406020403030605060102010204020107034
044161202110203030309091212120707040704040412075
045161201110203040304050603050507080605020408056

Table 23(Cont'd)

046261202120504020706050105030203030203040408042
047261100120302010103040203010202030104010204018
048161107120508051107041105060206040406080412077
049161108120302040306020506070204020202040309048
050161111120101020203030505030302020602010106024
051261107130405070603040203030504010505030207047
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056261106140102030404050603040203040503020306032
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058261106140202030203050403010204020402040305030
059161106140103040604050708030202010702030308042
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061220707110303030203040410010211021201060612053
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065120706210406030411080214060306030612010114074
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067220707220304030901140719050104020211080519080
068220711220101010302030404010102020201050105018
069120801220203020609020103050410020501010110038
070120707220204010104020401030107010402060207024
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072220702230303040204020203020202010204010404023
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074120709230202121106050710130311091008060213090
075120710230204091010020904090606050202020210063
076220705240201010203030305020406030502050106031
077220710240204010106020304050505020505040307042
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079120702240101010101010102010202010301040104008
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081240908210102010505020504020204010101030206026
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088240903220203070303060605050101020404040207041
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Table 23 (Cont'd)

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098240908240201030504030503020206020201030306027
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132220708330207010204020306010101010301040207024
133120801330304040404030305030106050601010306038
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Table 23(Cont'd)

136220706340709090302021002031009050206050210065
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175161106330202020303040402030101010301010104017
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177261109340102040504040402020203010505020205031
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