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ABSTRACT

Forty-two brain injured boys and 42 non brain injured boys (aged 11-6 to 12-6) were tested to determine the effects of increasing amounts of visual and auditory distraction on reading performance. The Stanford Achievement Reading Comprehension Test was administered with three degrees of distraction. The visual distraction consisted of either very few items per page, a normal amount of items, or pages with a superimposed jigsaw puzzle design; the auditory distraction was supplied by a tape recording of school sounds. Distractions did not affect the reading performance of either group, did not affect the brain injured any more than the normal, and there was no trend for comprehension to decrease concomitantly under combined increases of visual and auditory distractions. The high dual distraction negatively affected the non brain injured group more than the brain injured group. The conclusion was that the basic assumptions of teaching materials and methodology for brain injured children should be reevaluated. (Author/JM)

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EFFECTS OF VISUAL AND AUDITORY BACKGROUND ON READING ACHIEVEMENT TEST PERFORMANCE OF BRAIN-INJURED AND NON BRAIN-INJURED CHILDREN

August 1969

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JOHN L. CARTER, PH.D.

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The research reported herein was performed pursuant to a contract with Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

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Houston, Texas

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Without the cooperation of the administrators, teachers, and parents of children in the following schools the project could not have gotten off the ground:

HOUSTON INDEPENDENT SCHOOL DIST.

- Kolter Elementary School
- Andy Anderson Elementary School
- Roosevelt Elementary School
- Garden Villa Elementary School

PASADENA INDEPENDENT SCHOOL DIST.

- Gardens Elementary School
- Garfield Elementary School
- Kruse Elementary School
- South Houston Intermediate School

DEER PARK INDEPENDENT SCHOOL DIST.

- Clearwater Elementary School

ALDINE INDEPENDENT SCHOOL DIST.

- Aldine Junior High

CYPRESS-FAIRBANKS INDEPENDENT SCHOOL DISTRICT

- Arnold Eelementary School
- Lampkin Elementary School

SPRING BRANCH INDEPENDENT SCHOOL DISTRICT

- Frostwood Elementary School
- Spring Branch Elementary School
- Memorial Jr. High

The heart of this project lies in the testing of a great many children. I am especially grateful to Messrs. Johnny Poole, Steve Cary, and Mrs. Anitra Lourie for their time, efforts, and patience for the somewhat interesting and tedious task.

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Invariably, time hangs as a guillotine over the author's head when attempting to recognize those who have helped in such a project. If someone has been omitted inadvertently, let me take this space to express both my thanks and my appologies.

John L. Carter, Ph.D.
Principal Investigator

EFFECTS OF VISUAL AND AUDITORY BACKGROUND ON READING ACHIEVEMENT TEST PERFORMANCE OF BRAIN-INJURED AND NON BRAIN-INJURED CHILDREN

SUMMARY

A survey of the literature dealing with brain-injured children indicates that one of the main characteristics of these children is a disturbance of visual-perceptual functions. A more specific disturbance is that of figure-ground differentiation, and the tendency for these children to be more influenced than non brain-injured children by ground properties. It was assumed that these visual perceptual difficulties as well as similar difficulties in the auditory functions would make them more susceptible to the distraction of extraneous visual and auditory stimuli unrelated to a given performance task. The purpose of this study was to investigate the effects of varying visual and auditory distraction on a reading achievement test, and to compare the effects of increasing amounts of these two types of distraction on the reading performance of brain-injured and non brain-injured children.

Forty-two brain-injured children and forty-two non brain-injured children were selected from special education classes and regular sixth grade classes of fifteen public elementary schools in six independent school districts in the Houston (Texas) metropolitan area. All the subjects were boys between the ages of 11 years, 6 months and 12 years, 6 months, with I.Q.'s between 85 and 115 as determined by full scale scores of the Wechsler Intelligence Scale for Children. The subjects were individually administered the Stanford Achievement Test (Reading Comprehension) under different combinations of three visual distraction conditions and three auditory distraction conditions according to a Complex Latin Square Design. It was hypothesized that although both brain-injured and non brain-injured groups would be adversely affected by increasing amounts of visual and/or auditory background distractions, the brain-injured group would be affected to a significantly greater degree than the non brain-injured group. The data was subjected to analysis of covariance.

From analysis of the results, it was found that: (1) increased amounts of visual background distraction did <u>not</u> decrease the reading comprehension performance of the brain-injured and non brain-injured groups, separately or combined; (2) increased amounts of visual distraction did <u>not</u> affect the brain-injured group to a greater degree than the non brain-injured group; (3) increased amounts of auditory distraction did <u>not</u> decrease the reading comprehension performance of the brain-injured and the non brain-injured groups, separately or combined; (4) increased amounts of auditory distraction did <u>not</u> affect the brain-injured group to a greater degree than the non brain-injured group; (5) there was <u>no</u> general trend for reading comprehension to decrease concomitantly with combinations of increasing visual and auditory distraction for both groups, separately or combined.

Although the effects of increasing auditory and/or visual distraction did not have any significant effects on the reading achievement test performance of either group, there was a significant difference in the overall performance of the two groups in favor of the non brain-injured. This difference was evident with and without holding the I.Q. factor constant. A significant aspect in analysing the effects of the interaction of several variables was the fact that significant interactions were found when the I.Q. factor was used as a covariate (when I.Q. was held constant statistically) which would not have been evident had the I.Q. factor been disregarded. Another interesting and unexpected result indicates that the maximum distraction condition (the combined HIGH auditory distraction with HIGH visual distraction) negatively affected the non brain-injured group <u>more</u> than the brain-injured group.

From the results of the study it is concluded that: (1) the auditory and/or visual distraction conditions did not adversely affect the reading performance of either group; (2) the results and conclusions of other studies investigating similar comparative performances without the I.Q. factor as a covariate should be questioned; (3) the assumptions on which teaching materials and methodology for brain-injured children are based, as well as the materials and methodology themselves, should be questioned. It is felt that although these findings and their implications may be generalized to groups similar to the ones in the study, generalization to younger children is <u>not</u> warranted. Also, it must be kept in mind that these findings apply to a reading performance situation, <u>not</u> to a learning situation. Whether the generalization to younger children is warranted, and whether the findings apply to learning situations as well is yet to be proven.

INTRODUCTION

The role that perception plays in the classroom situation is considered of paramount importance by most authorities. The term perception refers to the reception, interpretation, and integration of auditory, visual, tactual, and kinesthetic stimuli. A dysfunction in any one or combination of these areas may have negative, and perhaps detrimental, effects on the child's adjustment to his environment, especially the formal learning situation. According to Cruickshank (6), "Any varying degree of imperception in the visual, auditory, or kinesthetic areas will be a forerunner to a learning problem."

Although all the senses are important in the acquisition of new knowledge, the "average" child is forced early, perhaps too early, in his life to rely on one of these---visual perception. This reliance predominantly on the visual area of perception is ultimately necessary, if not imperative, in our modern world where knowledge is acquired vicariously, through the printed word or symbol. The child who suffers visual impairment, whether optically or perceptually, will meet frustration or even failure. Getman (11) points this out when he states: "The child may come to school and have a clean bill of health from the physician, eye specialist, and tologist, but still lacking in perception. If so, he is in trouble.... (School) is a world of abstracts---a world of symbols: words, letters, numbers." Visual perceptual problems are often associated with cerebral impairment, and Werner (18) suggests that one of the basic difficulties in this area is the inability to form adequate figure-ground relationships. Goldstein (12) goes even further and states that the perceptual figure-ground relationship reflects a basic principle of neural organization.

The problem of perceptual disturbances is one that has been extensively studied, especially as it pertains to brain-injured children and adults. To many psychologists and educators working with exceptional children, the term "perceptual disturbance" has become almost synonymous with brain damage. This is probably due to the fact that there is continuing clinical evidence that many brain-injured children exhibit perceptual problems. Any recent book or article, including the Texas Education Agency's Handbook and Curriculum Guide for teachers of brain-injured children (17), points out that one of the main characteristics of brain-injured children is impaired perceptual functions, which seem to be fundamental to other behavioral characteristics attributed to these children. Fixation, distractibility, perseveration, and lability all seem to be directly related to figure-ground dysfunctions. The extent to which figure-ground relations affect academic achievement, and more specifically reading achievement, is yet to be determined conclusively.

Purpose of the Study

This study proposed to investigate the effects of varying degrees of visual and auditory background distractions on a reading performance task.

It was assumed that the distractions would negatively affect the reading performance of both the brain-injured and non brain-injured groups, but it was hypothesized that the distractions would adversely affect the brain-injured subjects to a significantly greater degree than the non brain-injured subjects. Several investigations have clearly indicated that disturbed perceptual functions, and particularly figure-background disturbance, frequently accompany central nervous system impairment. Although studies have related figure-background disturbances to academic achievement, these have investigated the two factors separately and then correlated the results. No studies have investigated the effects of visual background distractions on the reading material itself with and without simultaneous auditory distractions. It was felt that this study would provide information that may help determine the extent, if any, to which various degrees of visual and/or auditory distractions affect the reading performance of brain-injured and non brain-injured children.

Objectives

The objectives of this study were:

1. to compare the overall performance of the brain-injured with that of the non brain-injured group.

2. to determine the effects of increasing amounts of visual background distractions on reading test performance on brain-injured and non brain-injured children.

3. to determine the effect of increasing amounts of auditory background distractions on reading test performance on brain-injured and non brain-injured children.

4. to determine the effect of increasing amounts of simultaneous visual and auditory background distraction on reading test performance on brain-injured and non brain-injured children.

5. to compare the effects of visual and/or auditory background distraction by classification.

Review of the Literature

The work of Werner and Strauss and Lehtinen, based on Goldstein's studies of brain damaged soldiers and Veterans of World War I, seems to have started and given impetus to the research and investigations of perceptual dysfunctions in children. In their study of endogenous mentally retarded, brain-injured, and normal children, Werner and Strauss (18) found that the brain-injured subjects responded much more frequently to the background materials than to the objects in the foreground as compared to the other two groups. On responding to geometric figures of heavy circular dots and smaller dots presented tachistoscopically for 1/2 second, 52% of the brain-injured subjects responded to the background while only 28% of the familials did so. And on constructing patterns on a marble board, similar to the one presented by the examiner, 84% of the brain-injured subjects responded to the background while only 15% of the endogenous did so.

Werner seems to stress more importance to the figure-ground aspects of visual perception than Strauss. To him, "The figure-ground syndrome does not imply impairment of a unitary function..." It is concerned with a "psychobiologically fundamental performance that may be impaired because of a number of factors...which may appear antagonistic and yet be manifestations of the same syndrome." He makes this conclusion from a review of nine studies of normal, endogenous, and exogenous children matched for mental age. According to Werner, the study demonstrates that brain-injured children are more susceptible to interference from background stimuli than the other groups. Also, figure-ground disturbances are demonstrated in memory and conceptual thought as well as perception.

Strauss and Lehtinen (16), in their classical volume, The Psychology and Education of the Brain-Injured Child, Vol. I., which describes their work and investigations of brain-injured children in clinical and educational settings over a period of 20 years, conclude among other things that those children demonstrated "certain foreground-background visual perceptual disturbances which hindered the learning process...and a characteristic perceptual-motor syndrome concerned with the auditory, tactual, and visual fields." They point out, however, that "with certain exceptions, there does not exist at this moment a pattern or type of response characteristic and specific for the brain-injured defective child on standardized tests of intelligence, academic achievement, and visual-motor performance..." The same situation seems to persist today.

Following the work of Werner and Strauss and Lehtinen, Dolphin and Cruickshank (8) conducted a study which supported the earlier conclusions. They studied 30 cerebral palsied and 30 physically normal children matched individually by pairs. In response to tachistoscopically presented cards for .2 second, the preponderance of responses from the cerebral palsied group were those involving background. The normal children produced 48% figure responses in contrast to the CP group which produced less than 1% of such responses. On a similar task the inability of the CP group to select the original figure (multiple choice) regardless of the background was apparent at the .01 level of significance between the two groups. They hypothesized that the performance and the end result of the attempts was due to: (1) "dissociation or difficulty in relating parts to a total figuration," and (2) "the presence in the testing situation and in certain test items themselves of a multiplicity of extraneous stimuli only slightly related to the specific task."

In a later study, however, Cruickshank, Bice, and Wallen (5) seem to refute all earlier findings, presumably due to better experimental design and control of variables. The investigation studied 211 spastic-type CP children, 114 athetoid-type CP children, and 110 physically normal children, all with C.A. 6 to 16, I.Q. above 75, and a minimum M.A. of 60. The tests used to determine the influence of background upon the responses of the subjects included: (1) Tactual Motor Test, (2) Marble Board Test, (3) SVFET, (4) Maze Test, and (5) Disc Tests, I and II. The authors concluded that the notion of a general perceptual impairment was not supported. They found that by partialing out the variable, chronological age yielded generally lower, nonsignificant, correlation coefficients.

Gallagher (10) found similar results in a comparison of brain-injured and non brain-injured mentally retarded children. In his study of 48 institutionalized MR subjects (C.A. 6-9 to 41-5, I.Q. 35 to 76), significant differences between brain-injured and familial groups were not obtained for any of the measures of perceptual ability. He found wide variability in the brain-injured group, some doing very well, others very poorly, Although the brain-injured group was inferior to the familials on visual form tracing, the findings of the study indicate that not all brain-injured children are characterized by perceptual disturbances or other behavior disorders.

Noting that difficulty of the task and reproductive skill could be variables in defining the problem, Jones (12) found that accuracy in visual reproductive skill is a function of mental age. In his study of 40 normal children, 40 familial retardates, and 40 brain-injured retardates (all of equivalent M.A. 5 through 9) reproducing geometric figures under visual and auditory distraction, Jones found that normal children are more accurate than the mentally retarded when equated for mental age. The familials showed greater reproductive skill than the brain-injured, but only on difficult tasks. He also found that although the familial performance level was significantly reduced with distraction, the normal and brain-injured children showed no significant variation in performance with distraction. The effect of distraction was not significantly related to mental age of development.

Cruse's study (7), although not directly comparable, seems to contradict Jones' in regard to the effects of distraction upon the performance of brain-injured and familial retarded children. In his study of 24 brain-injured MR and 24 non brain-injured MR (C.A. 14, M.A. 6), no differences were found when the two groups were compared on a visual reaction experiment under distraction and non-distraction conditions. However, when the brain-injured group was subdivided into two groups, one with determinate and known etiology and the other with indeterminate etiology, the former had significantly longer mean reaction times. But he adds that although brain-injured children with known etiology appear to be more distractible than either familial retardates and children with indeterminate etiology, there seems to be little difference in their ability to benefit from minimization of environmental distractions. The findings tend to confirm those of Gallagher.

Considering Cruse's distraction conditions as distal distraction, Canter's (4) study of proximal distraction resulted in similar findings with brain-injured and non brain-injured psychiatric patients. The results of his study showed that the brain-injured subjects showed decrements in Bender performance under Background Interference Procedure compared to standard conditions, whereas little or no change was shown by the other patients. The BIP technique consisted of different intensity lines in jigsaw pattern. To Canter, the results suggest that the BIP is highly sensitive to the effects of brain damage.

In a more recent investigation of children with perceptual problems, Ayers (1) studied 100 children with suspected perceptual-motor dysfunction and 60 normal subjects (matched M.A., sex, I.Q.). Applying the R-technique factor analysis to 35 test scores plus age after a battery of tests individually given, the results yielded five major factors from the dysfunction group: (1) apraxia, (2) perceptual dysfunction---form and position in two dimensional space, (3) tactile defensiveness, (4) deficit of integration of function of two sides of the body, and (5) perceptual dysfunction---visual figure-background discrimination. She concluded that since these factors did not appear in the factor matrix of the control group, it appeared that these factors were not due to normal development processes but were the result of unyielding perceptual-motor deficits.

In relating visual perceptual problems to academic and reading achievement Kass' (14) study of 21 children with severe reading disability (C.A. 7-0 to 9-11, normal I.Q., in grades 2,3,4) revealed through scores on the ITPA that these children were poorer than the normal in: (1) Visual-Motor Sequential (reproducing a series of visual symbols)--integration level; (2) Visual Automatic (predicting a whole from a part---integration level; (3) Memory-for-Designs (manually representing a visual image)---integrational level; and (4) perceptual Speed (visually comparing detailed figures rapidly)---integrational level. These results were corroborated in part by Justison's (13) study of 398 third grade pupils in Montgomery County, Maryland. In correlating scores of the California Mental Maturity and Achievement tests with portions of the Bender and Ellis visual-motor tests, the results showed positive correlations between copying ability as a measure of form perception and the separate tests of achievement in reading, arithmetic, as well as mental maturity.

The importance of the influence of the age and developmental factors is supported by Feldman (9). In her study of 95 children at each level from kindergarten through grade 5, in which they were measured on intelligence, three visual perception tests, and two reading tests, the scores measuring general visual perception showed development with age. Reading skills showed a positive relation to general visual perception and form sequence and orientation scores, thus linking them with the visual perception scores and intelligence in their common factor variance. According to Feldman, the study supports the specificity of visual perception skills in relation to reading. The results suggest that lack of synchronization of visual perception and required reading skills might impede school achievement.

Although the groups used were different, Nealy's study (15) of the relationship of figure-background difficulty and school achievement in cerebral palsied children seems to contradict Feldman's results. In his study of 52 cerebral palsied subjects (C.A. 10-16, I.Q. 80-135) Nealy found that brain-injured children do, as a group, have more difficulty in differentiating figure from ground, both tactually and visually. However, the results showed little evidence of over-all figure-ground difficulty which may be predictive of reading and arithmetic achievement type items. Like many other studies, the sample of CP children were educationally retarded. He concluded, however, that there is no evidence to indicate that the educational achievement present was directly related to difficulty in differentiating figure from ground.

In summary, although most of the studies reveal that many brain injuried children have difficulty differentiating figure from ground in the various perceptual areas, there are some that seem to contradict this. Conflicting results and conclusions, however, seem to stem from differences in type of subjects studied, experimental design, types of measuring instruments, and functions measured. Few studies are directly comparable. Specific factors that seem to influence the findings are mental age, chronological age, and difficulty of the tasks presented to the subjects. Investigations relating visual-perceptual dysfunctions, and more specifically figure-ground difficulties, to reading achievement are also equivocal in their conclusions. Although children with reading disabilities do tend to show greater visual-perceptual problems, there seems to be no evidence that educational and reading achievement is directly related to difficulty in differentiating figure from ground. However, all the studies have related the various areas of visual-perceptual dysfunctions to products of learning, and not to the conditions of the actual performance.

Hypotheses

It was hypothesized that:

H_{1a} - Increased amount of visual background distraction (V-M and V-H) would decrease the reading comprehension scores of both brain-injured and non brain-injured groups.

H_{1b} - The increased amount of visual background distraction would affect the brain-injured group to a greater degree than the non brain-injured group---reading comprehension scores would be significantly lower for the brain-injured group than for the non brain-injured group under similar increasing amounts of visual background distraction.

H_{2a} - Increased amount of auditory distraction (A-M and A-H) would decrease the reading comprehension scores of both brain-injured and non brain-injured groups.

H_{2b} - The increased amount of auditory distraction would affect the brain-injured group to a greater degree than the non brain-injured group---the reading comprehension scores would be significantly lower for the brain-injured group than for the non brain-injured group under similar increasing amounts of auditory distraction.

H_{3a} - The increased amounts of simultaneous visual and auditory distraction would negatively affect both the brain-injured and non brain-injured groups---the reading comprehension scores would be significantly lower for both groups.

H_{3b} - The increased amounts of simultaneous visual and auditory distraction would negatively affect the brain-injured group to a greater degree than the non brain-injured group---the reading comprehension scores would be significantly lower for the brain-injured group than for the non brain-injured group.

Although the reading comprehension scores were expected to be lower under all three visual (V-L, V-M, and V-H) and/or auditory (A-L, A-M, and A-H) background distraction conditions for the brain-injured group, it was hypothesized that increased visual and/or auditory distraction would result in significantly lower scores for the brain-injured group than for the non brain-injured group. Accordingly, minimum differences in group scores would result under minimal distraction conditions (V-L, A-L) and maximum differences in group scores would result under maximum distraction conditions (V-H, A-H).

The null hypothesis statistical technique was employed by means of analysis of covariance with the Complex Latin Square Design (Lindquist, 1953) The .05 level of confidence would denote statistical significance.

PROCEDURE

The Stanford Achievement Reading Comprehension Tests, Intermediate I-Forms W, X and Y, (with the format changes called for in the experimental design) were administered individually to the subjects in small rooms cleared of all unnecessary visual and auditory distractions within the school building. After each subject was seated, the test instructions were read according to the SAT Manual of Instructions. Upon giving the initial instructions for each subtest, the examiner sat directly behind the subject until the test time was up or until the subject completed the test. Three sub-tests (30 minutes each) were administered to each subject. The order of presentation of subtests was predetermined according to the experimental design. The regular time limit for each of the subtests was adhered to.

The figure below is a pictorial representation of the experimental design followed in testing the subjects (and for analysis of the data).

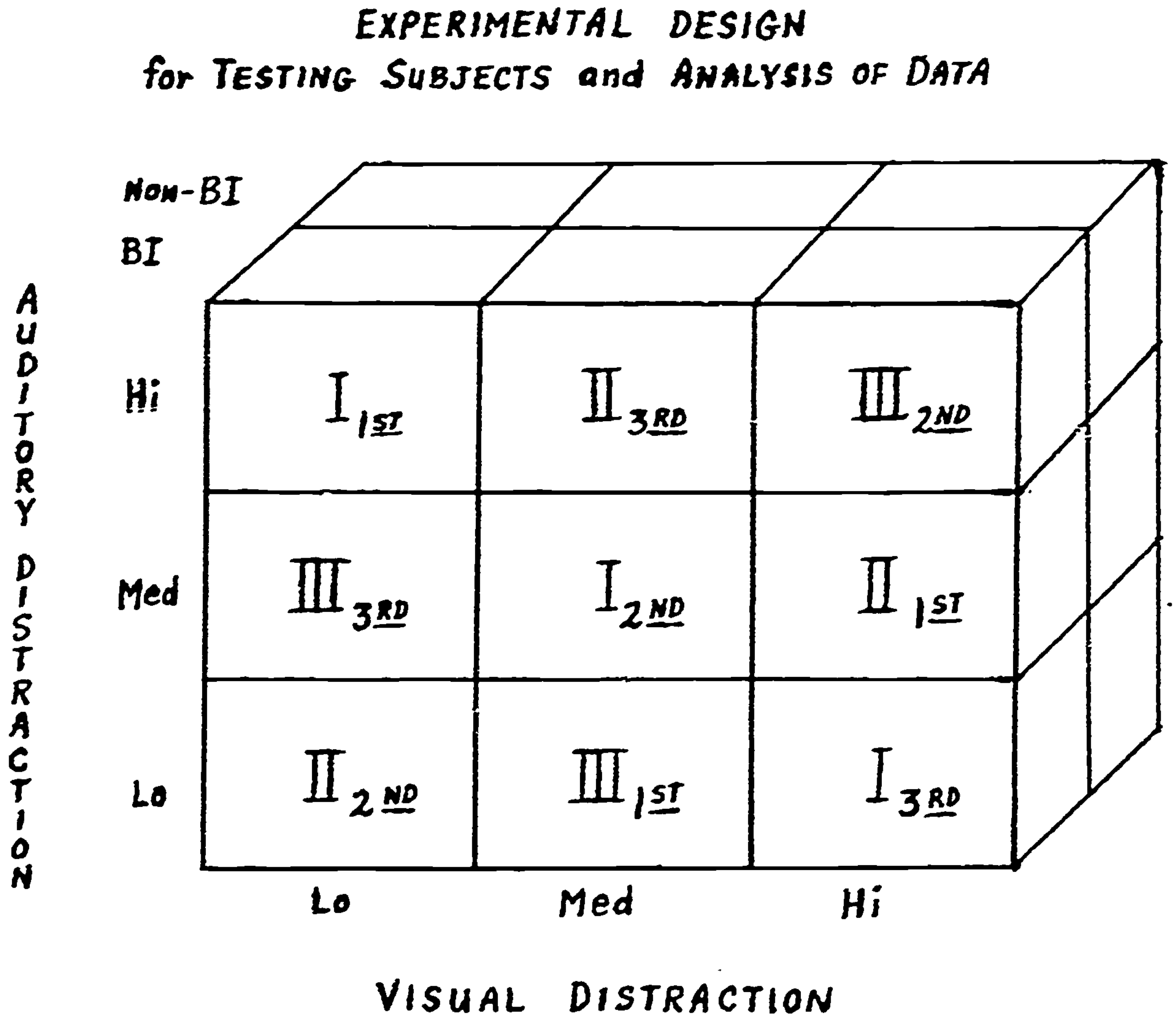

Figure 1

Variables

Visual Background (V-L---Low background distraction; V-M---Medium background distraction; V-M---High background distraction)

I. V-L test items per page included approximately one-fourth of the total page.

II. V-M test items and format on each page were the same as the original (standard SAT).

III. V-H test items and format on each page were the same as the original, but with light green jigsaw puzzle design as background.

Auditory Background

I. A-L no extraneous sounds (silence)

II. A-M simulated (taped) low typical classroom sounds---decibels: 45 to 55.

III. A-H simulated (taped) louder typical classroom sounds (same as in II)---decibels: 55 to 65.

The forty-two (42) brain-injured subjects were randomly assigned to three groups, I, II, and III, and were administered the Stanford Achievement Test (Reading Comprehension) under the experimental conditions indicated in Figure 1. The groups were administered the achievement tests in the following order:

Group I	1st: A-H, V-L; 2nd: A-M, V-M; 3rd: A-L, V-H.
Group II	1st: A-M, V-H; 2nd: A-L, V-L; 3rd: A-H, V-M.
Group III	1st: A-L, V-M; 2nd: A-H, V-H; 3rd: A-M, V-L.

All three groups were given Form W (of the SAT) first, Form X second, and Form Y last. All subjects were given all three tests at one sitting with a three minute rest between the second and third test.

The group of 42 non brain-injured subjects were administered the same tests following the same procedure outlined for the brain-injured group.

Subjects

The testing sample included 84 subjects (all boys), 42 taken from the upper elementary special classes for the minimally brain-injured, and the other 42 taken from the regular sixth grade classes. All the subjects were taken from the public schools. The following criteria was used in selecting the subjects included in the final experimental testing:

1. All subjects scored within the normal range of intelligence (85 to 115 I.Q.) as measured by the Full Scale Score of the Wechsler Intelligence Scale for Children. All WISC's were administered within one year prior to the experimental testing situation.

2. All subjects had a chronological age of between 11-6 and 12-6 at the time of testing.

3. None of the subjects had physical or sensory handicaps that would have prohibited normal use of the testing materials.

4. All the brain-injured subjects had been in a special class for a minimum of two (2) years.

Selection Procedure

The subjects were selected from fifteen elementary and junior high schools in six independent school districts in the Houston (Texas) metropolitan area. The preliminary selection was conducted in the following manner: A total of one hundred thirty-two subjects with chronological ages between 11 years, 6 months and 12 years, 6 months, at the time of testing, was administered the Wechsler Intelligence Scale for Children for classification purposes.

All the brain-injured subjects in the special class or classes at each participating school were administered the WISC. All those scoring within the normal range of intelligence (85 to 115 I.Q.) were included in the experimental study. Once the number of brain-injured subjects meeting the criteria in a particular school was determined, an approximately equal number of non brain-injured subjects was also selected from the school. This was done by randomly selecting a regular sixth grade class from a list of all sixth grade classes in that school. The researcher then made a list of all the boys meeting the age criteris in that class (obtained from the school's permanent records). An appropriate number of subjects was randomly selected from the list and given WISC's. Only those scoring within the I.Q. range of 85 to 115 I.Q. were included in the final experimental testing.

Materials

Testing materials included three forms (W, X, Y) of the Stanford Achievement Test (Paragraph Meaning), Intermediate I, for grade 4 to the middle of grade 5. All three forms of the test were reproduced by photocopying and put together as three separate tests. Since they were photocopies, the items were exactly the same as in the original tests. The format changes to meet the three visual distraction conditions in the experimental design included the following:

1. LOW DISTRACTION: Each of the three forms was printed so that the number of test items on each page included approximately one-fourth of the total page. This was done by cutting items from the original test and pasting enough items in the center of a blank sheet so as to include one-fourth of the page.

2. MEDIUM DISTRACTION: Each of the three forms was reproduced by photocopying in exactly the same format as the standard test.

3. HIGH DISTRACTION: Each of the three forms was reproduced by the same manner as was done for MEDIUM DISTRACTION except that it was printed on sheets completely covered by a jigsaw puzzle design in light green lines. In other words, the standard test format was superimposed on a light green jigsaw puzzle design..

A tape recorder with a thirty-minute tape of recordings of classroom and school sounds was used for the auditory distraction conditions. The sounds were recorded: (1) in an actual elementary classroom during an arts and crafts period and a geography class period, (2) during a recess and physical education period, (3) in the school cafeteria during a lunch period, and (4) in the hall as the children returned to the classrooms from lunch. All the different sounds were edited and spliced so as to form a continuous thirty-minute tape. The thirty-minute tape was then transferred to another tape and adjusted, by means of a sound level meter, so that approximately ninety-five percent (95%) of the sounds varied between 45 and 55 decibels (at a distance of seven feet). This last tape, the master tape, was then played back and the tape recorder calibrated so that the volume could be preset to one spot on the dial at 45 to 55 db (at seven feet) and to another spot at 55 to 65 db. In other words, the same master tape could be played at two volume levels, 45 to 55 decibels and 55 to 65 decibels, by merely changing the volume knob from one precalibrated spot to another. These two volume levels were used as the MEDIUM and the HIGH auditory distraction conditions. During the LOW auditory distraction condition the tape recorder was turned off.

Since three examiners were necessary to administer all the experimental tests within the time period available, two additional tapes were reproduced from the master tape, and two other tape recorders were calibrated so that the sound levels for the MEDIUM and HIGH auditory conditons were exactly the same for all three tape recorders used. Spot checks were made with the sound level meter during the experimental conditions so as to insurance that the MEDIUM and HIGH volume ranges were within the original caliabrations.

RESULTS

The data were subjected to analysis of covariance, employing the Complex Latin Square Design (Lindquist, 1953) as outlined earlier in the PROCEDURE and represented pictorially in Figure 1. A summary of the results is presented in Table 1.

From the analysis of the results it can be concluded that:

1. Since the correlation (r=0.4957) between the reading achievement test scores and the I.Q. scores was significant, analysis of covariance was performed on all between-groups analyses.

2. The overall reading achievement test performance of the two groups (brain-injured and non brain-injured) was significantly different in favor of the non brain-injured, with or without consideration of I.Q.

3. The interactive effect of the auditory distractions and the visual distractions (the order of presentation of the various combinations of auditory and visual conditions), between subjects, caused significant differences on test performance.

4. The interaction of auditory distractions, visual distractions, and group membership, between subjects, caused significant differences on test performance.

5. The effects on test performance of increasing auditory distraction were not significant for both groups combined.

6. The effects on test performance of increasing visual distraction were not significant for both groups combined.

7. The interaction of auditory distraction conditions and visual distraction conditions, within subjects (between mean scores of the three tests taken by the same subjects), was significant.

8. The interaction of auditory distraction and group membership, within subjects, did not cause any significant effects on test performance.

9. The interaction of visual distraction and group membership, within subjects, did not cause any significant effects on test performance.

10. The interaction of auditory distraction, visual distraction, and group membership, within subjects, was not significant.

According to the analysis of the data there was a significant difference between the overall performance of the two groups studied, i.e., the non brain-injured group (Non-BI) obtained significantly higher scores on the reading achievement tests than the brain-injured group (BI). The difference between the two groups remained significant when they were compared both with and without regard to I.Q. However, there were other comparative effects that did change when the I.Q.'s were taken into account. The interactive effect of the auditory and visual conditions as well as the interactive effect of the auditory conditions, the visual conditions, and group membership (BI and Non-BI) on test performance were not significant when I.Q. scores were not taken into account. But when I.Q. was held constant, both of these sets of interactions were significant. In other words, when I.Q.'s for both groups were "equalized" statistically, significant differences became evident which would not have been evident had I.Q.'s not been taken into account in comparing test performances.

The effects of the auditory conditions were not significant for both classification groups combined. This means that increasing auditory distraction had no significant effect on the achievement test performance, i.e., increasing the amount of auditory distraction during test performance did not bring about significantly lower (or higher) reading achievement test scores (when both the BI and the Non-BI subjects were taken as one group). The same applied to the visual conditions. When both groups were combined, the increasing amounts of visual distraction did not have any significant effect on the subjects' reading achievement test performance. Similarly, the interaction of the auditory conditions and group membership was not significant, indicating that the effects of the amounts of varying

SUMMARY OF THE ANALYSIS OF COVARIANCE RESULTS

SOURCE	SUM-YSQ*	df	MEAN-SQ	F	p	SUM-XSQ**	SUM-XY	df	COVAR	F	p
BETWEEN SUBJECTS	42875.000	83				7228.664	555663.000	83			
Classification	21543.125	1	21543.125	80.124	.001	2070.000	3855.521	1	9003888.000	114.771	.001
Auditory x Visual	67.563	2	33.781	0.126	N.S.	72.000	-39.438	2	1553248.000	41.924	.001
Auditory x Visual x Classification	292.188	2	146.094	0.543	N.S.	12.333	33.813	2	1369344.000	41.566	.001
$Error_b$	20972.125	78	268.873			5074.328	551813.063	77			
Covariance (r=0.4957)								1		26.714	.001
WITHIN SUBJECTS	3180.000	168									
Auditory	9.063	2	4.531	0.269	N.S.						
Visual	35.188	2	17.594	1.044	N.S.						
Auditory x Visual	427.563	2	213.781	12.684	.001						
Auditory x Classification	9.375	2	4.688	0.278	N.S.						
Visual x Classification	32.625	2	16.313	0.968	N.S.						
Auditory x Visual x Classification	36.875	2	18.438	1.094	N.S.						
$Error_W$	2629.313	156	16.855								
TOTAL	46055.000	251									

* Y - Achievement Test scores
** X - I.Q. Test scores

TABLE 1

auditory distraction by groups did not differ significantly. The effects of the interaction of the visual conditions and group membership were also found to be not significant, indicating that the increasing amounts of visual distraction by groups did not significantly affect the performance on the reading achievement tests either. In other words, the increasing amounts of auditory or visual distraction did not have any significant effects on the achievement test performance of the brain-injured subjects or on the non brain-injured subjects, and, therefore, no significant differences between the two groups relative to either of the two types of distracting conditions.

The interaction of the auditory conditions and the visual conditions (with both BI and Non-BI groups combined) was significant. This means that when the performance scores of the three testing combinations of auditory and visual conditions for each of the sub-groups (I, II and III) were compared with the other two sub-groups, significant differences were evident. That is, although neither the varying auditory conditions nor the varying visual conditions (taken separately) had any significant effect on the subjects' performance of the reading achievement tests, the interactive effects of the auditory conditions <u>and</u> the visual conditions were significant. (But <u>not</u> with increasing negative effects with increasing amounts of distraction, as might be expected.) The interaction of the auditory and visual conditions merely indicates that significant differences in test performance were found under different combinations (different cells in the matrix) of the auditory and visual conditions.

The interaction of the auditory conditions, the visual conditions, and group membership (BI and Non-BI), between subjects, was significant. ("Between subjects" in this design means "between orders - I, II, III.") This interaction indicates that there was a significant difference in the patterns of the mean scores for the three orders of the brain-injured group and the patterns of the three orders of the non brain-injured group. This can be observed in Figure 2. However, the interaction of the auditory conditions, visual conditions, and group membership, within subjects, was not significant. ("Within subjects" in this design means "within the same order" because the subjects in all three combinations of conditions in any one order were the same.) This interaction indicates that there was no significant difference in the patterns of the three mean scores in the brain-injured group and those within each of the three orders in the non brain-injured group. This can be observed in Figure 3. In other words, there was a significant difference in the patterns of test scores by classification groups (BI, Non-BI) when taken by the order or sequence of testing conditions (Figure 2), but there was no significant difference in the patterns of test scores by classification groups when taken by subgroups (Figure 3).

Comparison of Ach. Test Score Means by Order of Tests

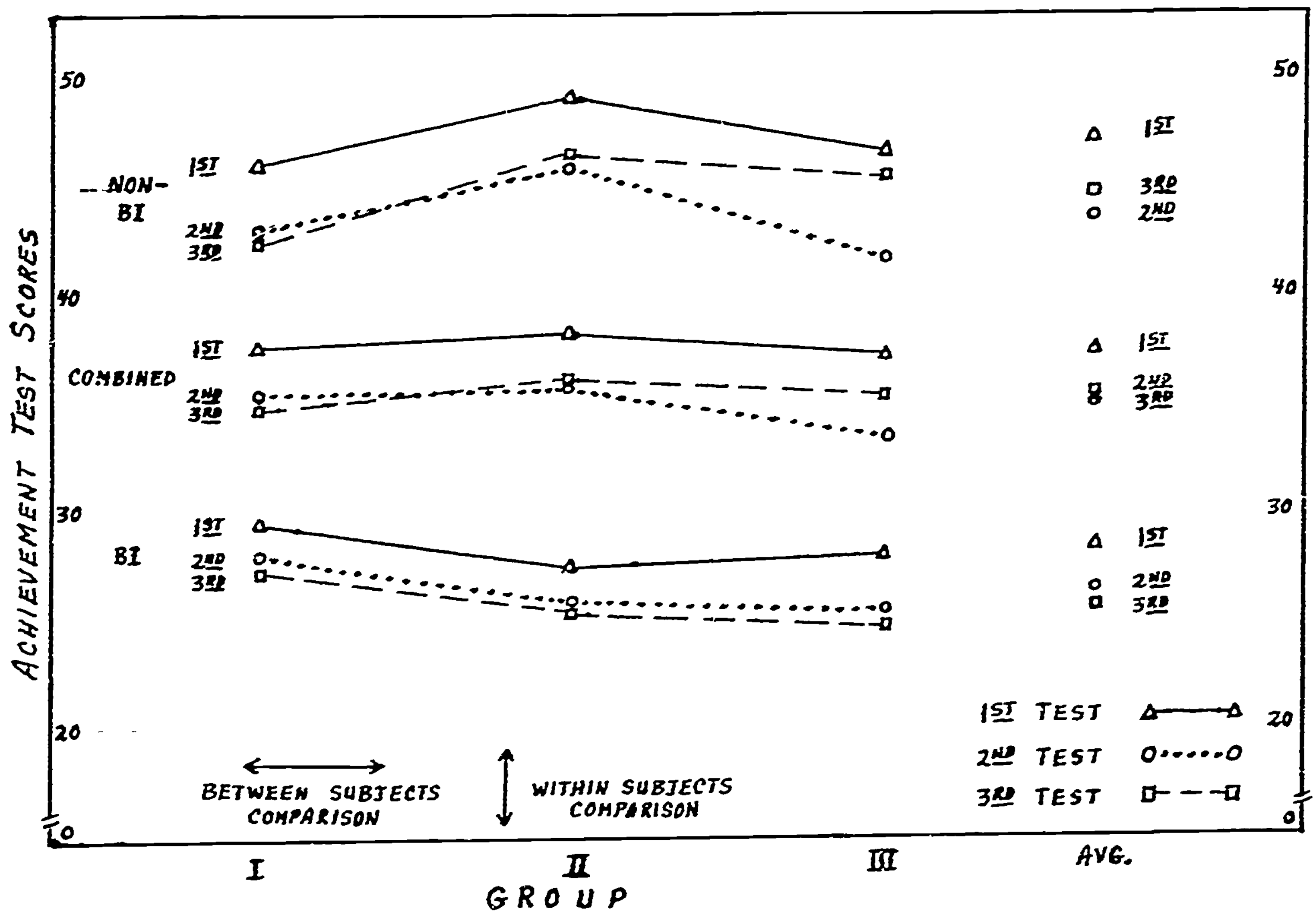

Figure 2

Comparison of Ach. Test Score Means by Groups

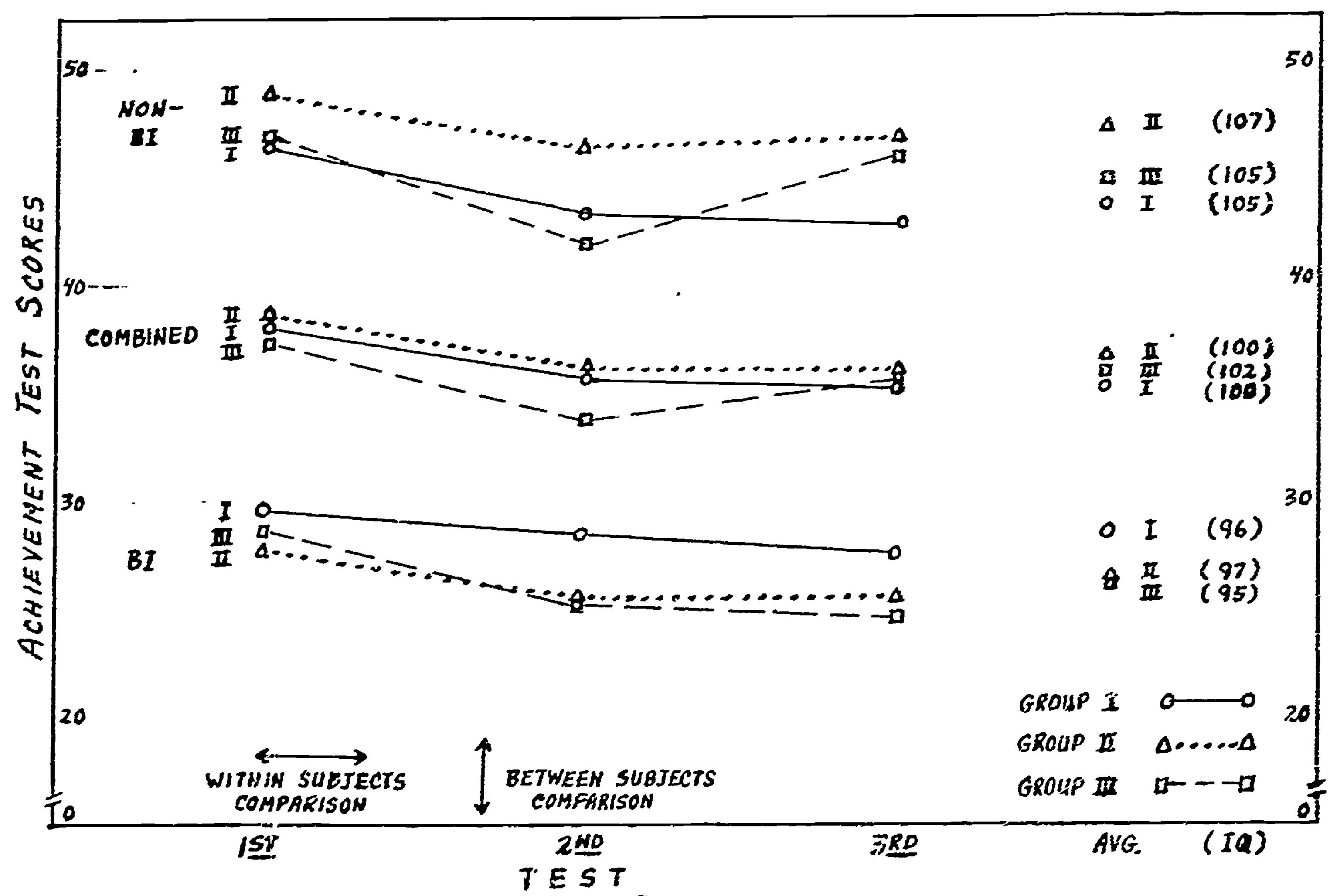

Figure 3

DISCUSSION AND CONCLUSIONS

On the basis of the analysis of the data:

H_{1a} - The first research hypothesis was not accepted. The increased amount of visual background distraction did not decrease the reading comprehension scores of the brain-injured and the non brain-injured groups, separately or combined.

H_{1b} - The second research hypothesis was not accepted. Since the increasing amounts of visual distraction did not significantly affect the performance (reading comprehension scores) of either group, it can be concluded that the increased amount of visual distraction did not affect the brain-injured group to a greater degree than the non brain-injured group.

H_{2a} - The third research hypothesis was not accepted. The increased amount of auditory distraction did not decrease the reading comprehension scores of the brain-injured and the non brain-injured groups separately or combined.

H_{2b} - The fourth research hypothesis was not accepted. Since the increasing amounts of auditory distraction did not significantly affect the reading comprehension scores of either group, it can be concluded that the increased amount of auditory distraction did not affect the brain-injured group to a greater degree than the non brain-injured group.

H_{3a} - The fifth research hypothesis (as stated) could not be accepted or rejected on the basis of the statistical technique for the experimental design employed. The analysis of the data indicates that there was a significant interaction of the visual conditions and the auditory conditions, but not necessarily with a decrease in reading comprehenshion test scores as a function of increasing distraction. (However, it is apparent from visual inspection of Tables 1 and 4 that there was no general trend for reading comprehension test scores to decrease concomitantly with combinations of increasing visual and auditory distraction.)

H_{3b} - The sixth research hypothesis (as stated) could not be accepted or rejected for the same reason given for the fifth hypothesis. (However, it is apparent from visual inspection of Tables 1 and 4 that there were no general trends for the reading comprehension test scores to decrease concomitantly with combinations of increasing visual and auditory distractions for the brain-injured and the non brain-injured groups, separately or combin ed. Hence, it is apparent that the increased amounts of simultaneous visual and auditory distraction did not negatively affect the brain-injured group to a greater degree than the non brain-injured group.)

T A B L E 2

MEANS OF CORRECT ITEM SCORES ACCORDING TO DISTRACTION CONDITIONS

AUDITORY		VISUAL L	VISUAL M	VISUAL H	
H	*	29.50	25.43	25.21	26.71
	**	46.38	46.50	41.93	44.92
	†				35.82
M		24.86	28.07	27.50	26.81
		45.57	43.00	48.93	45.83
					36.31
L		25.50	28.07	27.21	26.93
		46.07	46.72	42.43	45.07
					36.00
	*	26.62	27.19	26.64	26.82
	**	45.99	45.41	44.43	45.27
	†	36.31	36.30	35.53	36.05

* BI
** Non-BI
† Combined (BI, Non-BI) Mean

T A B L E 3

MEANS OF CORRECT ITEM SCORES ACCORDING TO ORDER OF TESTS

GROUPS		TEST 1st	TEST 2nd	TEST 3rd	
I	*	29.50	28.07	27.21	28.26
	**	46.33	43.00	42.43	43.92
	†	37.92	35.54	34.82	36.06
II		27.50	25.50	25.43	26.14
		48.93	46.07	46.50	47.16
		38.22	35.79	35.97	36.65
III		28.07	25.21	24.86	26.05
		46.72	41.93	45.57	44.74
		37.39	33.57	35.22	35.39
	*	28.36	26.26	25.83	26.82
	**	47.33	43.66	44.83	45.27
	†	37.89	34.96	35.24	36.05

* BI
** Non-BI
† Combined (BI, Non-BI) Mean

T A B L E 4

COMPARISON OF MEANS OF COMBINED DISTRACTION LEVELS

Combined Distraction Level

CLASS	L_{aud}-L_{vis}	M_{aud}-M_{vis}	H_{aud}-H_{vis}	
BI	26.78	27.00	26.68	26.82
NON-BI	45.53	45.62	44.68	45.27
	36.16	36.31	35.68	36.05

T A B L E 5

MEAN I.Q.'S ACCORDING TO GROUPS

CLASS	GROUP I	GROUP II	GROUP III	
BI	95.86	97.21	94.50	95.86
NON-BI	104.93	107.00	105.43	105.97
T.M.	100.39	102.11	99.97	100.93
Diff.	9.07	9.79	10.93	10.11

It is apparent from the results of this study that none of the research hypotheses was supported. Neither the visual distraction conditions nor the auditory distraction conditions had significant effects on the reading achievement test performance of the brain-injured or the non brain-injured groups. This seems to be contrary to what would be expected, especially of the brain-injured group. Although the interaction of the visual and auditory distraction conditions was found to be significant (within and between subjects), indicating that the combined effects of both types of distraction did affect test performance, it is apparent from Figure 4 and Table 3 that increasing amounts of simultaneous visual and auditory distraction did not bring about concomitantly lower performance scores. This is also contrary to what would be expected. The significant interaction of the auditory and visual conditions apparently is attributable to the fact that the performance scores were consistently higher on the first test given to all the subjects (BI and Non-BI) than on the second or third test, regardless of the combined distraction conditions under which the tests were taken.

The fact that the reading performance scores were consistently higher on the first test for all three sub-groups (I, II, and III) in both classification groups (BI and Non-BI) indicates that: (1) the subjects were "fresh" and possibly eager to participate during the first testing situation, and that this "freshness" wore off or they became fatigued as they approached the second and third test, or (2) the first test, Form W of the SAT, was easier than the other two tests, Forms X and Y. The first alternative seems to be the least plausible since it would have been expected for the subjects' performance to have been lower on the third test (after one hour of continuous work on the first two tests) than on the second test. Yet, the mean performances scores (Table 3 and Figure 3) do not indicate this.

Regardless of the cause or causes for the better performance on the first test, visual inspection of the mean scores by order of tests on Table 3 and Figure 2 points to another consideration in regard to another assumption commonly found in the literature about a "characteristic" of brain-injured children. It is commonly stated that these children exhibit a short attention span, possibly related to their distractibility, which interferes with their academic performance. This assumption was not supported by the findings of this study. The short attention span should have been evident in their performance by progressively lower scores on the second and third test. This was not found in the results. The difference in mean scores between the first and second test cannot be attributed to this factor since the non brain-injured group's performance showed the same difference.

Another factor that apparently accounts for the significant interaction of the two types of distraction conditions is the comparatively lower mean performance scores of the non brain-injured group on the second test of sub-group III (taken under the HIGH visual and HIGH auditory conditions) and on the third test for sub-group I (taken under the HIGH visual and LOW auditory conditions). This factor seems to be one of the more disconcerting and unexpected of the results of the study since it indicates that the maximum visual distraction conditions (under HIGH and LOW auditory distraction) negatively affected the non brain-injured group's performance more than it affected the brain-injured group, when compared to their own classification group's performance under the other conditions (see Table 2 and Figure 4). This fact seems to be contradictory to the fact that no significant differences in test performance were found with increasing visual distraction conditions in the non brain-injured group. The apparent discrepancy can be accounted for by noting that the mean performance score on the first test for sub-group I (under HIGH visual and MEDIUM auditory distraction) was the highest for the non brain-injured group, thus raising the mean performance score for the three HIGH visual distraction conditions.

The inclusion in this study of the I.Q. score as a covariate seems to have been a crucial factor. Interactions which were found to be significant would not have been evident without "equalizing" the I.Q. factor for both classification groups. This fact raises questions about the validity of the interpretation of the results of other studies comparing the performances of different groups (mentally retarded, brain-injured, cerebral palsied, normal, etc.) without employing the I.Q. factor as a covariate. It is apparent that comparing the performance of two or more groups of different I.Q. levels, or even the comparison of performance of different indiv iduals within a group, without the I.Q. factor in the actual manipulations of the comparisons (rather than merely stating the mean I.Q. differences after the comparisons are made) can lead to misleading or completely erroneous conclusions. The importance of this consideration is clearly brought out in this study by the fact that the interaction of the auditory c nditions, visual conditions and group membership within subjects (where the I.Q. could not be taken into account since it considered the comparative performance of individuals with themselves) was not significant; and the fact that the interaction of these three variables between subjects was not significant when the I.Q. factor was not taken into account. But this same interaction between subjects was found to be significant when I.Q. was taken into account.

Most studies comparing the performance of brain-injured children in academic and other nonacademic tasks with that of non brain-injured children indicate that there is a tendency for the brain-injured group to show a greater variability in distribution of scores than the non brain-injured. Visual inspection of the distribution of scores in this study (see Figures 5 and 6) indicates that the variability of performance found in other studies is supported by the results of this investigation. The comparative wider distribution of performance scores of the brain-injured group was more evident when compared in terms of subgroups and order of tests (Figure 5) than when all scores for each group were compared (Figure 6).

Comparison of Achievement Test Score Means of Auditory Conditions and Visual Conditions (by Classification)

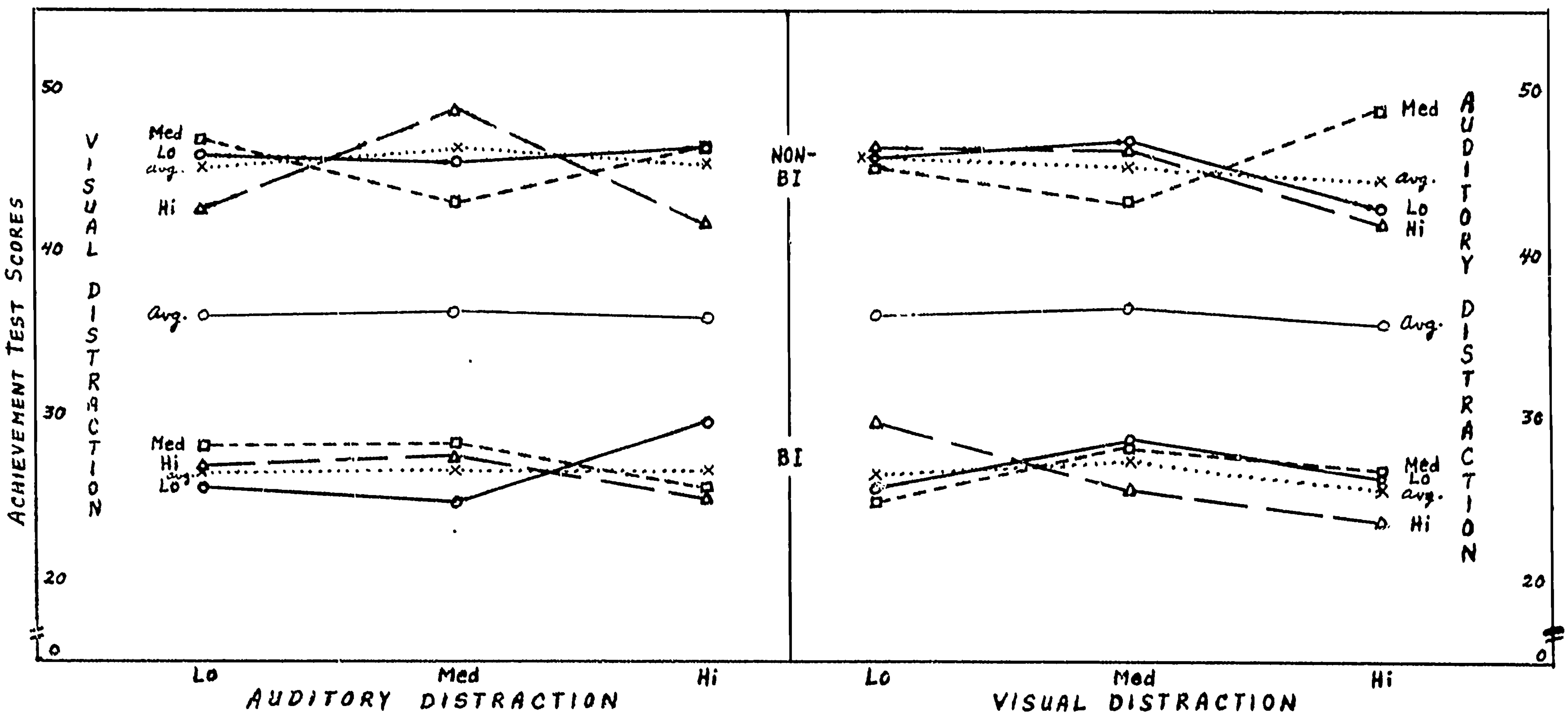

Figure 4

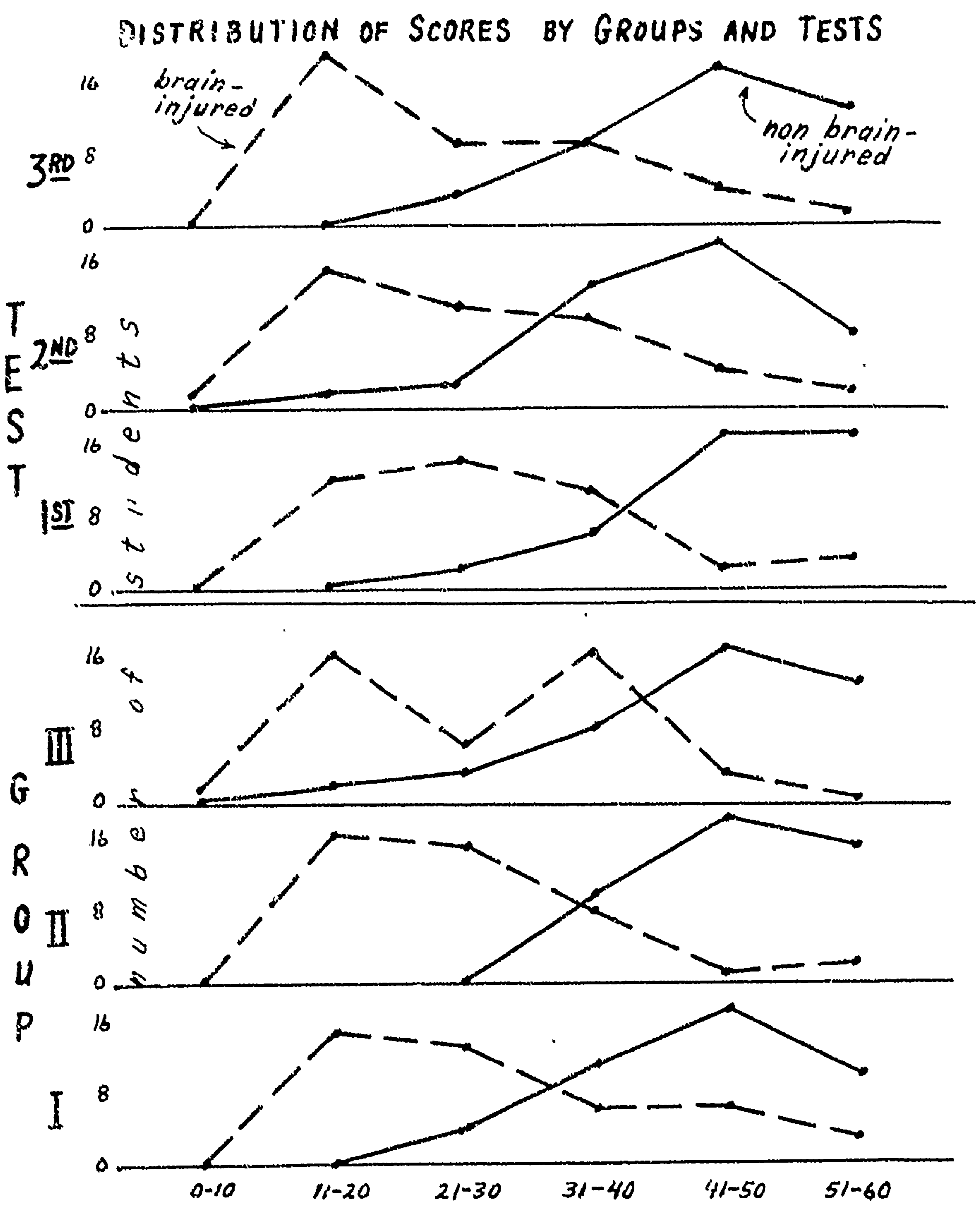

Figure 5

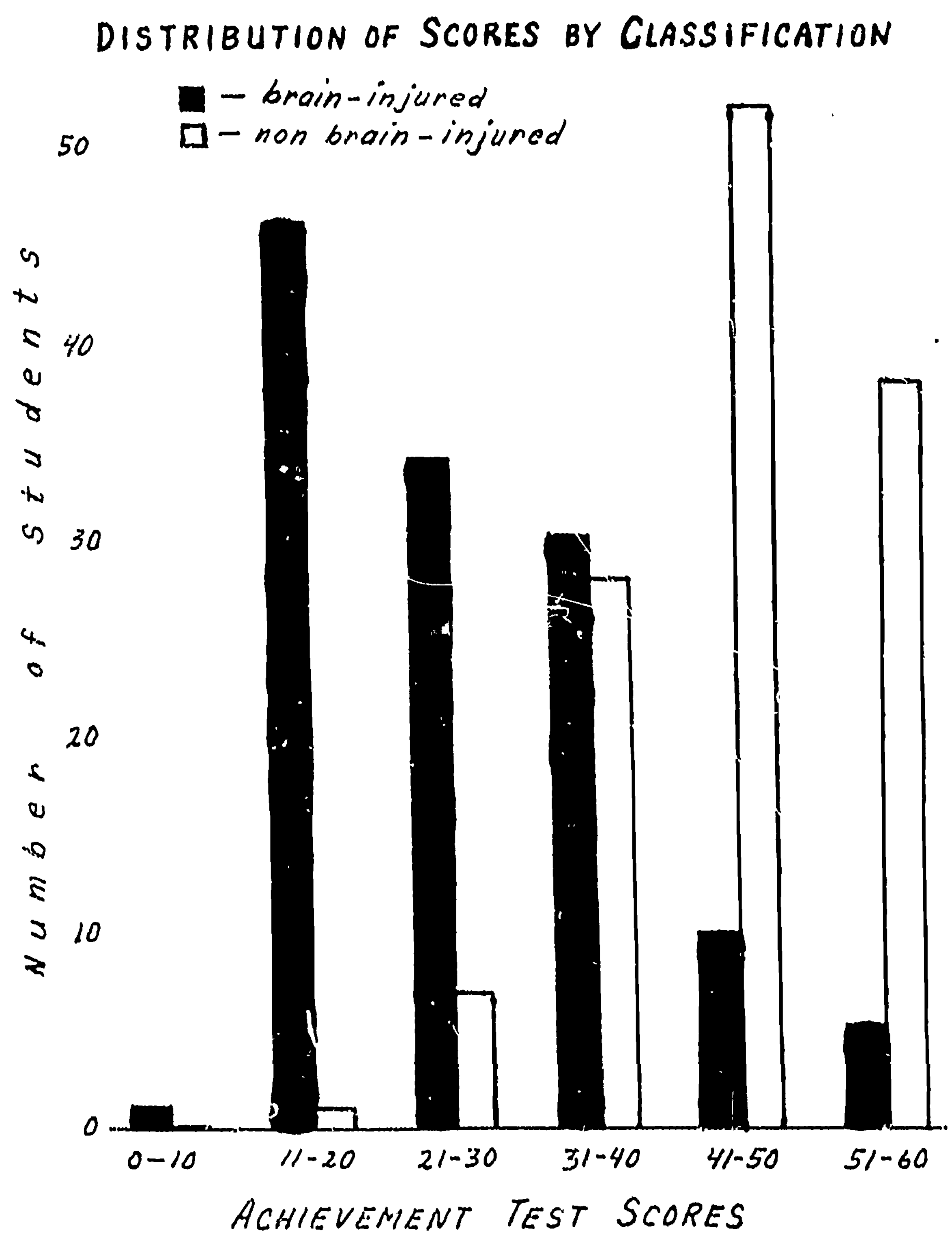

Figure 6

The results of this study also raise questions about the teaching methodology espoused by many educators who work with brain-injured children in this age range. Much of the literature on teaching the brain-injured states or implies that these children are very distractible and hypersensitive to auditory and visual distraction, and that this condition greatly impedes their academic performance. In order to counteract this, much time and energy is spent on teaching materials and methodology which reduce the amount of auditory and visual distraction. The results of this study would indicate that questions should be raised regarding the validity of the assumptions upon which these efforts are based, as well as the usefulness of the materials and teaching methodologies based on these assumptions.

It must be pointed out, however, that the conclusions from the results of this study should not be interpreted to apply to all brain-injured or non brain-injured children. Although the size of the sample of the study and the variables controlled would warrant some generalization as to the applicability of the findings to upper elementary grade children, to imply that these findings would apply to children in the primary grades would not be warranted. As a matter of fact, it would be assumed that should such a study similar to this one be conducted with children in the primary grades very different results would ensue. But that is a hypothesis yet to be proven.

REFERENCES

1. Ayers, Jean A., "Patterns of Perceptual-Motor Dysfunction in Children: A Factor Analytic Study," Monograph Supplement No. 1, Perceptual And Motor Skills, 20:355-368, 1965.

2. Birch, Herbert G., ed., Brain Damage in Children, New York: The Williams and Wilkins Company, 1964.

3. Birch, H. G. and Ira Belmont, "Perceptual Analysis and Sensory Integration in Brain Damaged Persons," Journal of Genetic Psychology, 105:173-179, 1964.

4. Canter, Arthur, "A Background Intereference Procedure to Increase Sensitivity of the Bender Gestalt Test to Organic Brain Disorders," Journal of Consulting Psychology, 30:91-97, 1966.

5. Cruickshank, William, and Orville G. Johnson, eds., Education of Exceptional Children and Youth, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1958.

6. Cruickshank, W. M., H. V. Bice, and N. E. Wallen, Perception and Cerebral Palsy, Syracuse, New York: Syracuse University Press, 1957.

7. Cruse, Daniel B.,"The Effects of Distraction Upon the Performance of Brain Injured and Familial Retarded Children," in Readings on the Exceptional Child, E. Philip Trapp, and Philip Himelstein, eds., New York: Appleton-Century-Crofts, Inc., 1962.

8. Dolphin, Jane E., and William Cruickshank, "The Figure-Background Relationship in Children with Cerebral Palsy," Journal of Clinical Psychology, 7:228-231, 1951.

9. Feldman, Shirley Clark, "Visual Perception Skills of Children and Their Relation to Reading," (Abstract) Dissertation Abstracts, Vol. 22, 1961., pp. 1084-1085.

10. Gallagher, J. J., "A Comparison of Brain Injured and Non Brain-Injured Mentally Retarded Children on Several Psychological Variables," Monograph of the Society for Research on Child Development, No. 2, 1957.

11. Getman, G. N., and Elmer R. Kane, Psychology of Readiness, Minneapolis Minnesota: Programs to Accelerate School Success, Inc., 1964.

12. Goldstein, Kurt, "The Effects of Brain Damage on Personality," Psychiatry, 15:245-260, 1952.

13. Jones, Robert W., "Cross-sectional Views of Visual Reproduction and the Effects of Distraction on Visual Reproduction by Brain Damaged Retardates, Familial Retardates, and Normal Children," (Abstract) Dissertation Abstracts, 25:2068, 1964. (from Mental Retardation Abstracts, Vol. 2, 1965. p. 209.)

14. Justison, Gertrude G., "Visual Perception of Form and School Achievement (an Exploratory Study of the Relationship Between Form Perception and School Achievement Among Third Grade Pupils in the Public Schools of Montgomery County, Maryland)," (Abstract) Dissertation Abstracts, Vol. 22, 1961-1962.

15. Kass, Corrine Evelyn, "Some Psychological Correlates of Severe Reading Disability (Dyslexia)," (Abstract) Dissertation Abstracts, Vol. 23, 1963.

16. Lindquist, E. F., Design and Analysis of Experiments in Psychology and Education, Boston: Houghton-Mifflin, 1953.

17. Neely, James Hamilton, A Study of the Relationship of Figure Background Difficulty and School Achievement in Cerebral Palsied Children. (Dissertation) Ann Arbor: University Microfilms, Inc., 1958.

18. Strauss, A. A., and L. E., Lehtinen, Psychopathology and Education of the Brain Injured Child. Vol. I, New York: Grune and Stratton, 1947.

19. Texas Education Agency, Handbook and Curriculum Guide for Teachers of Programs for the Minimally Brain Injured, Austin, Texas, 1965.

20. Werner, Heinz, and Alfred A. Strauss, "Pathology of Figure-Ground Relation in the Child," Journal of Abnormal and Social Psychology, 36:236-48, 1941.

21. Werner, Heinz, and A. Weir, "The Figure-Ground Syndrome in the Brain Injured Child," Int. Record of Med. Gener. Pract. Clinics, 169: 362-367, 1956. (in Brain Damage in Children, Herbert G. Birch, ed., New York: The Williams and Wilkins Company, 1964.)