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To investigate procedures whereby schools may achieve maximal results with otherwise normal underachieving pupils with neurologically based language-learning disorders. 100 such subjects were studied over a 2-year period. Fifty experimental subjects remained in regular classes in school and received individualized teaching outside of school hours from specially trained clinicians. Fifty matched control subjects were enrolled in special education classes and did not receive clinical teaching after school. Half of the experimental and half of the control subjects had anticonvulsive medication prescribed by their physicians; the others did not. Tests of academic achievement and mental functioning indicated that the experimental groups made significantly greater gains in both variables than did the control. However, the medicated groups did not make greater gains than the unmedicated. (Author)

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U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

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Empress Y. Zedler, Ph. D.

Southwest Texas State College
San Marcos, Texas

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The research reported herein was performed pursuant to a contract with the 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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The project director wishes to express her deep gratitude to Professor Olga A. Dominguez, who was directly responsible for planning and supervising the clinical teaching program in this study.

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SUMMARY

The purpose of this project was to investigate a procedure whereby schools might achieve maximal educational results with children who (a) are normal or above in intelligence, (b) have specific language-learning disabilities, (c) have medically diagnosed minimal neurological impairment, and (d) are presumed to be unable to adjust to or profit from a regular school program (Texas Education Agency, 1965).

The specific objectives were as follows:

1. To test the relative efficacy of teaching such children (a) in the regular, general classes of their respective schools, supplemented by individual clinical teaching after school hours, or (b) in the special, self-contained classes for "minimally brain-injured children" as set-up in their respective schools under authorization of Texas statute (TEA, 1965).

2. To investigate whether such children made significantly greater gain in mental function and/or academic achievement when they were taking anticonvulsive medication, than when they were not.

Subjects for the study were selected from among a population of about six hundred school children who met the following seven criteria: (a) enrollment in school for at least one and no longer than eight years, (b) normal visual and auditory acuity by standardized screening tests in the school, (c) no gross motor impairment, (d) a verbal or performance IQ on the WISC (Wechsler, 1949) of eighty or above, (e) academic underachievement of one-half a school grade or more, determined by Educational Grade (as established by standardized achievement test) minus School Grade, (f) specific language disorders, as evidenced in speaking, understanding the speech of others, reading, and/or writing, and (g) medically confirmed cerebral dysfunction.

Fifty experimental subjects were selected to receive individualized clinical teaching after school as an adjunct to their regular participation in general classroom activities. Half of the experimental group had anticonvulsive medication prescribed by their physicians as treatment for their cerebral dysfunction. The other twenty-five subjects in the experimental group did not have anticonvulsive medication prescribed by their physicians.

A control group of fifty subjects was selected from the parent population so as to be approximately equal to the experimental subjects in sex distribution, and to have group means and standard deviations similar to the experimental group in regard to age, WISC full-scale IQ, and scholastic achievement. Half of the control group had anticonvulsive medication prescribed by their physicians and the other twenty-five subjects in the control group did not. The control group differed from the experimental group in that they were enrolled in special education classes as defined by the Texas Education Agency (TEA, 1963) rather than in regular classes, and they were not included in the individualized clinical teaching program of this study.

The mental ability and academic achievement of the one hundred subjects were measured with the WISC and a standardized achievement test before and after two years in their respective educational programs. Ancillary data were accumulated by qualified social workers in interview with parents of the one hundred subjects six months after termination of the two-year study to determine (a) school placement of the children, and (b) parents' and children's attitudes toward the two types of educational management.

Pre- and post-test data were statistically compared to determine whether or not (a) there had been significant changes in the mental functioning and scholastic achievement of the experimental group, (b) these changes were also evidenced in the control group, and (c) there had been significant changes between the medicated and unmedicated subgroups in both the experimental and control populations. Ancillary opinion ratings were compared for differences between experimental and control groups.

Analysis of test data strongly supported the hypothesis that pupils with neurologically based language-learning disabilities would make significantly greater gain in mental function and in scholastic achievement if they remained in regular classes and received supplementary clinical teaching, than if they were placed in special education classes and did not receive supplementary clinical teaching. Results of the study showed significantly greater gains in mental function and in scholastic achievement by the experimental group than by the control group.

Analysis of the data did not support the hypothesis that the medicated group would make greater gains than the unmedicated group in the variables under study. Post-testing showed no significant difference in scholastic achievement gain between the medicated and unmedicated subgroups within or between the experimental and control groups. The unmedicated group gained slightly but significantly more than the medicated group on WISC full-scale and verbal IQ's.

Ancillary data showed that a high percentage of children from the experimental group were maintaining competitive positions in regular classes six months after termination of this study, whereas a very small percentage of children from the control group had been returned to the regular school program, although such return is a stated purpose of the special education classes.

Implication from this study is that full participation in regular classes supplemented by clinical teaching outside of school hours should replace enrollment in special education classes for otherwise normal children who have language-learning disabilities and medically diagnosed cerebral dysfunction or "minimal brain injury."

INTRODUCTION

Problem. A phenomenon in the history of child development as a scientific study is the keen interest and vigorous activity engendered in a particular problem area when the demands of society enforce a shift of focus. We are now witnessing a productive and perhaps chaotic period in the history of man's concern with learning disabilities which are associated with language disorders, presumed to be neurologically based, in otherwise normal children. At the beginning of the present decade throughout the educational community, and particularly in the State of Texas, there erupted a sudden awareness of the deleterious effect of specific language disabilities upon the scholastic achievement of children.

> The population about whom there has been most concern are school children with basically adequate intellective, sensory, motor, and emotional equipment, who have had the opportunity to learn by methods and under conditions which have been successful with others, but who nonetheless have failed to acquire expected competence in one or more, and probably in all, of the aspects of language - understanding speech, speaking, reading, and writing - and whose presenting complaint is overall academic deficiency. (Zedler, to be published).

It is generally known (a) that learning to speak, read, and write depend upon integrity of the central nervous system, and (b) that academic failure may result from deviation in brain function which may be apparent only in language-learning disorders (Clemmens, 1961; Myklebust, 1960). In educators' search for the best way to deal with specific learning disabilities in otherwise normal pupils there is danger of creating a category of pathology (Dunn, 1968). There is danger of forgetting the vast heterogeneity of the phenomena included under the rubric of neurologically based language-learning disabilities. Hirsch (1963) points out that individual differences are generated by properties of organisms which are fundamental to behavioral science. He warns against assuming uniformity of expression of any behavior under study. Yet educators are constructing a homogeneous group of children defined by concepts of neurological disability or "brain injury", when academic failure or underachievement is actually the one common and dependable characteristic of the group.

In 1963, in Texas there was statutory implementation of special classroom instruction for "Minimally Brain-injured Children". The eligibility of children for such special classes was based upon their being "normal or above in intelligence, but having learning difficulties directly attributable to an organic defect caused by a neurological condition, and who are unable to adjust to or profit from a regular school program" (TEA, 1963). The stated purpose of the program is to provide instruction "in an educational setting that will meet the needs of such children by assisting them to function educationally and emotionally in such a way that whenever possible they will be prepared to return to the regular school program" (TEA, 1963).

Two implications from the stated definition of the children and purpose of the program seemed vulnerable to challenge. First was the

implication that such children could not profit from a regular school program, and second was the implication that the program offered in the specially created classes did actually prepare children to return to the regular school program. That these implications needed to be tested seemed apparent. Certain questions needed answering. Could such children profit from remaining in the regular classroom if they were given supplementary help after school? Were those who were placed in the special classes actually being returned to regular classrooms? And, being returned, were they able to achieve with their agemates who had not served a term or more in a special education class? The danger of having created a category in special education which must perpetuate itself by a search for and a clinging to customers seemed to be a possibility.

Pilot studies and clinical experiences at Southwest Texas State College prior to the proposal of this study had indicated that, with supplementary language training and clinical teaching after school hours, scholastically underachieving children with medically diagnosed neurological impairment, who were otherwise normal, could profit mentally, socially, and scholastically by remaining in the stimulating environment of a regular, general classroom (Davis, 1962).

Numerous studies can be found in the literature negating advantages to be gained from isolation or self-contained grouping (Bruner, et al, 1967; Goldstein, et al, 1965; Meyerowitz, 1967). More than a decade ago Brosin (1957) reported that brain function in normal college students was adversely affected when they were isolated in cubicles with physical stimulation kept at a low level. Their intellect deteriorated, as did their problem-solving abilities and their powers of concentration. Yet isolation cubicles are standard equipment in many of the special education classrooms created for pupils with neurologically based learning problems.

The literature was searched for studies to support practices of assignment to special classes composed of pupils with similar disabilities. At the time this study was proposed the writer could find only one study of note reported relative to the management of pupils with neurologically based learning problems within the program of a regular public school system (Cruickshank, 1961), and one relative to their management in a private or special school (Strauss, 1947). The public school study developed the concept that alteration of the total school environment was the essential factor in assisting these children. Both studies reported favorably on the use of isolation, reduced stimulatory techniques, and homogeneous grouping. Neither study, however, attempted to measure gain made by experimental subjects against gain made by control subjects with the same disabilities who remained in the socially stimulating mainstream of regular education and received supportive therapy which was not isolative, reduced in stimulation, or based upon homogeneous grouping.

A study was proposed which would keep otherwise normal, scholastically underachieving pupils with medically diagnosed minimal neurological impairment in their regular classrooms, (a) so that they might enjoy full group relationships and participation with normal heterogeneously grouped agemates, and (b) so that the schools might maintain a single curriculum for all pupils of comparable age and intellect, with the addition of

specialized clinical teaching after school hours for those who needed it. It was hypothesized that such children would make greater gain in mental function and academic achievement under these conditions than if they were removed from the regular classroom and consigned to a special education class.

It was decided to investigate a second parameter in the management of such children; namely, the influence upon mental function and scholastic achievement of anticonvulsive drugs medically prescribed to relieve central nervous system disorders. This decision resulted from the high interest manifested by physicians, educators, and parents as to the possibility that such drugs might favorably influence a child's powers of concentration, and thus contribute to greater academic achievement and higher mental functioning.

With the shift of focus away from sociological and environmental factors as the most likely causes of failure to learn language skills, toward the concept that the learning of language is dependent upon the integrity of the nervous system, medicine and pedagogy have come closer together in mutual search for remediation. Baldwin and Kenny (1966) suggest the following three premises as bases for exploring the effectiveness of pharmacologic treatment of children with special learning disabilities:

1. The brain is involved in learning, behavior, and emotional control,
2. The brain is a physiological mechanism,
3. As such, it is subject to modification of function by pharmacologic agents.

The literature shows that four types of medications have been used in investigating medical treatment of behavior disorders - stimulants, antihistamines, anticonvulsants, and tranquilizers. As early as 1937, Bradley reported on the effectiveness of pharmacologic stimulants in increasing attention span in hyperactive, distractible children. The same investigator (Bradley and Bowen, 1940) reported that amphetamine sulfate improved the school performance of children. There is a report (Effron and Freedman, 1953) on use of an antihistamine with a group of 44 children and improvement of behavior noted in 61 percent of them. In a study of 20 delinquent boys (Brown and Solomon, 1943) improved behavior patterns were noted with use of the anticonvulsant, sodium diphenylhydantoin (Dilantin). Walker and Kirkpatrick (1947) reported "encouraging" results which warranted "further follow-up and study" from use of Dilantin on an out-patient basis with "a group of behavior problem children with abnormal electroencephalographic findings." Pasamanick's (1951) study of 21 boys with abnormal EEG's did not support the Brown and Solomon (1942) findings that anticonvulsive drugs modified behavior or performance significantly. Lindsey and Henry (1942) and Eisenberg (1964) reported unfavorable results from use of phenobarbital as a tranquilizer in controlling hyperkinetic behavior of children. Zimmerman (1956) observed that the behavior of 71 percent of 200 children with abnormal EEG's improved when they were treated with an anticonvulsant (Dilantin). Baldwin and Kenny (1966) observed medication responses in 100 children referred to a university hospital because of behavior disorders, and found that Dilantin in combination with phenobarbital was effective in improving behavior.

The results reported in these studies were based upon judgmental ratings by parents, physicians, and, in a few cases, teachers. None reported statistically measurable results. None reported the use of control groups of children who did not receive medication. A few reported use of placeboes. None attempted to measure quantifiable change in academic achievement of an experimental and control group of children. All focused attention upon opinion ratings of change within the same children before and after medication.

One study (Hammill and Helfer, 1964) was reported which, among other objectives, attempted to quantifiably measure the difference between changes in the cognitive processes of children with "convulsive equivalents" who received anticonvulsive medication, and those who did not. In this study twenty-four children were in the experimental group who received medication, and twenty-four were in the control group who were not medicated. The groups were studied over a period of only three months. Pre- and post-tests of intelligence, visual-auditory perception, and personality were administered. Pre- and post-rating items were obtained from parents and teachers. The data from this study were submitted to factor analysis, and differences in standard factor scores between the medicated and unmedicated groups were determined by analysis of variance. Findings favored the medicated group on three cognitive factors - perceptual awareness, symbol aptitude, and cognitive flexibility. Convergent thinking was apparently not affected by medication. A fourth cognitive variable, School Achievement, which was primarily a teacher report item, favored the nonmedicated group.

An implication from all studies relative to effectiveness of drug therapy on the behavior of children was that further research was needed. It was apparent that such further research should meet the following criteria: (a) compare similar groups of medicated (experimental) and nonmedicated (control) subjects; (b) have an adequate number of subjects- at least 50 in each group after attrition - available for post-testing; (c) yield quantifiable scores for statistical analysis of differences between the experimental and control subjects, and (d) extend over a sufficiently long experimental period.

In conference with the physicians responsible for medically confirming neurological impairment in the children to be studied in this project, it was decided to incorporate an investigation of the effect of anticonvulsive medication on the academic achievement and mental function (a) of the children who were to remain in the regular classrooms and receive supportive clinical teaching after school, and (b) of those who were to be taught in special classes and not receive supportive clinical teaching.

Objectives. The purpose of this project was to investigate the proposition that scholastically underachieving children with adequate sensory, motor, emotional and intellectual mechanisms, and with medically diagnosed "cerebral dysfunction" (Denhoff, 1960), would show significant improvement in academic achievement and mental function if they remained in regular classrooms, and, in addition, were given concentrated, supplementary, clinical teaching by trained clinicians, provided they took anticonvulsive medication as prescribed by their physicians during the period of experimentation.

The research design was planned to provide information on the following hypotheses regarding scholastically underachieving children with medically confirmed cerebral dysfunction:

1. That such children would make significantly greater gain in academic achievement and mental function when left in their regular classrooms and given supplementary clinical teaching than when removed from regular classrooms and taught in special, homogeneously grouped classes, and

2. That such children would make significantly greater gain in academic achievement and mental function when they received anticonvulsant medication than when they did not.

METHODS

General Design. To implement the investigation it was decided to utilize as the referral population all those children who had been referred to the Speech, Hearing, and Language Clinic at Southwest Texas State College between the dates of January 1, 1958, and September 1, 1964. This number was approximately 600.

This referral population was then screened for all those children who met the following criteria: (a) enrollment in public school of at least one and no longer than eight years; (b) adequate visual and auditory acuity, as established by screening tests in their schools; (c) no gross motor defects i.e., able to use their bodies for all regular classroom activities and not obviously crippled; (d) a verbal or performance IQ on the WISC (Wechsler, 1964) of 80 or higher; (e) academic underachievement of one-half a school year or more, as determined by Educational Grade, attained on the GVR General Achievement Test (Gray, Votaw, Rogers, 1962), minus actual school placement grade; (f) specific language disabilities manifest in concept formation and/or oral or written language skills as determined by the child's classroom teacher and by speech pathologists at Southwest Texas State College; and (g) medically confirmed cerebral dysfunction. Approximately 300 children met these seven criteria.

From the screened population an experimental sample of 65 subjects were randomly selected for an individualized clinical teaching program as an adjunct to their regular classroom activities. Sixty-five experimental subjects were selected to care for attrition with the expectancy that 50 might complete the study.

After conference with the physicians of these 65 experimental subjects, it was decided that about half of them would receive anticonvulsive medication, half of them would not. Those receiving medication while remaining in their regular classrooms and participating in the adjunctive clinical teaching program were designated as Group A. Those who also participated in the regular classroom and clinical teaching program but did not receive anticonvulsive medication were designated as Group B.

Another sample of 65 subjects were selected who met the seven criteria, so as to have group means and standard deviations similar to the sample comprising Groups A and B in regard to age, WISC scores, and scholastic achievement. In addition, the proportion of females in this sample was similar to that in the previously selected sample (Groups A and B). This sample differed from Groups A and B in the type of educational program they received. They were enrolled in homogeneously grouped special education classes, as defined by Texas statute (TEA, 1963), rather than in regular classrooms; and they did not participate in the individualized clinical program of this study. These 65 subjects comprised the control groups for the study.

About one-half of the control subjects took medically prescribed anticonvulsive medication. These were designated in the study as Group C.

The other subjects in the control sample had the same type of educational program as those in Group C, but they did not take medically prescribed anticonvulsive medication. They were designated as Group D.

The mental functioning and academic achievement of all the subjects in Groups A, B, C, and D were measured with the WISC (Wechsler, 1949) and the General Achievement Test (Gray, Votaw, and Rogers, 1962) before and after two years in their respective educational programs.

Data from the pre- and post-testings were subjected to statistical analysis to determine if statistically significant changes had arisen between the four groups. Specifically the data were compared to determine whether or not (a) there were significant changes in the mental functioning and/or academic achievement of the experimental subjects (Groups A and B) remaining in regular classes when tested prior to and following supplementary, individualized, clinical teaching; (b) these changes were also evidenced in the control subjects (Groups C and D) taught in special education classes without the supplementary individualized clinical teaching; and (c) there were significant changes between the groups in both the experimental and control samples who received anticonvulsive medication (Groups A and C) and those who did not (Groups B and D).

Each of the 130 subjects were assigned a number from 01 to 130. Predetermined procedures which will be described later were used to keep the experimental and control groups approximately equal throughout the investigation in spite of attrition. At the termination of the study it was possible to perform statistical formulations according to the schematic design shown in Appendix A, using 100 subjects arranged as shown in Figure 1. Formulas used for the t and F tests appear in Appendix B.

Experimental Group A N = 25 Regular classes + Individual instruction + Medication	Experimental Group B N = 25 Regular classes + Individual instruction	All experimental N = 50 Groups A & B
Control Group C N = 25 Special education classes + Medication	Control Group D N = 25 Special education classes	All control N = 50 Groups C & D
All medicated N = 50 Groups A & C	None medicated N = 50 Groups B & D	

Figure 1. Composition of Groups

Composing Groups. Although this study hypothesized that underachieving pupils with neurologically based language-learning disorders would make significantly greater gains in academic achievement when left in their regular classrooms and given individual, supplementary training than when removed to special education classes, and that they would also make greater gains in academic achievement when given anticonvulsive medication, the success of the study was not dependent upon such findings. The importance of the findings lay in discovery of the most effective methods of dealing with such children. It was necessary, therefore, at the start of the study to equate carefully the groups of pupils to whom the varied methods were applied.

Criteria as set forth in the original design for formulation of the groups were as follows:

1. With respect to sex, both experimental and control groups at the beginning consist of the same proportion of boys (or girls).

2. With respect to age, acceptable equality of means and standard deviations must exist.

3. With respect to initial academic attainment, acceptable equality of means and standard deviations of GVR Achievement Test scores must exist.

4. With respect to intelligence, acceptable equality of means and standard deviations of WISC full-scale IQ's must exist.

To aid further in securing fair equality, the investigators determined for each pupil and took into account the following variables:

1. His grade deficiency; i.e., his pre-test Educational Grade minus his School Grade, and

2. His learning rate; i.e., his pre-test Educational Age divided by his Chronological Age on the date of pretesting.

While the study called for initial matching of groups and the final comparison of these groups, initial matching of pairs of individuals became a practical necessity in the process. It would have been quite simple to have used age alone to secure almost exact equality of ages, or IQ alone for equality of intelligence, or test scores alone for equality of achievement; but when a child of a given age was given a place in an age group, his IQ and achievement score went with him. The relative levels of his IQ and achievement score might have differed widely from the level of his age as well as from each other. To overcome this difficulty, all measures influencing the matching were converted to a T-score scale (mean of 50 and SD of 10) computed from the total potential experimental population of sixty-five subjects and applied to both the experimental and the control groups in conversions.

Theoretically the pretesting of the scholastic achievement of all subjects was done on the same day. Because of the scattered locations

of subjects this was not practicable. Therefore, it became necessary to convert for each subject the record of his pre-test results on the pre-testing date to a common date for all, namely, September 1, 1964. The following steps were taken to insure that terminal groups, with whatever differences might then exist, were equal in academic achievement and learning rate at the beginning of the study:

1. From the Educational Grade level of a subject, his Educational Age was read from the Educational Profile on the GVR test booklet.

2. From the date of birth of the subject his Chronological Age on the date of the pre-test was determined.

3. The Educational Age was then divided by the Chronological Age to determine each subject's learning rate to the date of pre-testing. These ratios ranged from .64 to 1.04.

4. By use of a straight-edge on a specially prepared nomograph, this ratio (E.A.:C.A.) was then applied to the school period between September 1, 1964, and the date of actual pre-testing. The resulting reduced segment of normal grade progress was subtracted from the subject's pre-test Educational Grade. The remainder was the subject's calculated pre-test Educational Grade on September 1, 1964. Thus September 1, 1964, became the "starting line" from which progress for all groups was measured at post-testing time.

5. The school grade for each subject on September 1, 1964, was subtracted from his calculated Educational Grade on that date to determine the extent of his academic deficiency.

The next step was to "fix" at the beginning and hold throughout the study the four groups whose differences in school achievement and mental functioning at the termination of the study were to be compared and attributed to the impact of different methods and treatments. In doing this all known measures that might affect progress, other than the experimental factors to be applied, entered into the initial formulation of the groups. These factors were age, sex, IQ, learning rate, Educational Grade, academic deficiency, and Achievement Test level and form administered.

A card for each subject was prepared containing his data together with T-score equivalents. The T-scores on each card were averaged except for ages. Cards were classified by ages (nearest half-year as of September 1, 1964) for the experimental subjects and for the control subjects separately. Then for a given age, say 11½, the experimental cards were spread out with the control cards beside them, and an attempt was made to match cards with equal or nearly equal average T-scores. If an acceptable match from the control cards could not be found for an experimental card, the control cards for a half-year lower and a half-year higher were examined for a match of average T-score. This process accomplished two things; namely, (a) ages were kept comparatively close together, and (b) plus and minus measures of other matching factors were offset by corresponding minus and plus measures.

Substitutes from the pool of potential control subjects were preselected to replace each individual control subject who might be lost from a control group. Similarly, the loss of an experimental subject resulted at once in the removal of a predetermined control subject. These were "paper" operations carried out by the statistician in charge which in no way altered any methods or treatments being used with the subjects in the study. The twenty-five subjects in each of the four groups, along with the pool of potential replacements for each of the four groups, received the same treatment throughout the two-year study. The classroom and clinical teachers involved were never aware as to which of the children were replacements and which were original members of the groups under study.

By these processes, each of the thirty-six experimental subjects receiving medication (Group A) was provided a companion control subject of the same sex, receiving medication (Group C). One of the twenty-nine experimental subjects receiving no medication (Group B) moved away before completion of the matching, but a companion control subject of the same sex, receiving no medication (Group D) was found for each of the remaining twenty-eight.

After the pairs of matched cards were clipped together, the control subject's GVR T-score was subtracted from the experimental subject's GVR T-score, and, in like manner, the control subject's IQ T-score was subtracted from the experimental subject's IQ T-score. These two differences might be opposite in sign or they might both be of the same sign. Therefore, in some cases they added to zero, in some to plus, and in some to minus. The sums, thus, became indices to the relative nicety of matching -- the nearer the sum to zero, the nicer the fit.

The thirty-six pairs from Groups A & C were then arranged in order of nicety of fit and the first twenty-five taken for this study. That left eleven pairs from Groups A & C to be held in reserve to replace, in the order listed, one or more couples lost for any reason from the original twenty-five couples. If any individual subject was lost, his companion was dropped (on paper but not from treatment) and the pair replaced from the top of the list of pairs of available replacements. For example, if A-No. 017 was the first to be lost, his companion C-No. 117 was removed also, and the pair was replaced by Reserve A-No. 051 and companion Reserve C-No. 151. The same replacement couple was used if C-No. 117 was the first to be lost, in which case A-No. 017 was removed from the statistical grouping.

Selection of the twenty-five pairs and arrangements for replacements for Groups B & D were made in the same manner as described for the pairs in Groups A & C. In view of the fact, however, that only three matched pairs were left in reserve for Groups B & D, the following plan was devised to protect the final total of twenty-five pairs of subjects needed for groups B & D:

1. From the surplus of unused subjects in Group D acceptable companions were found for as many as possible of the selected twenty-five subjects in Group B and listed by the side of the corresponding companion subject from Group D.

2. As many as three pairs could be lost by the drop-out of a subject from the original twenty-five in either Groups B or D, and those pairs could be replaced by reserve pairs. If more than three pairs were disrupted by loss of a subject from Group D, however, then a replacement was made for the "D" member of the pair, provided there was a suitable substitute from Group D listed by the side of the drop-out.

The object of these preliminary precautions was to try to insure termination of the study with fifty experimental subjects who had been prematched with fifty control subjects. If selection of replacements for losses by attrition had been left to decisions made after progress of the study was underway and after the effects of methods were becoming discernible, the investigators would have been burdened with the necessity of making personal, subjective decisions that could have cast a cloud of suspicion on final conclusions.

The precaution of maintaining reserves under the same treatment as the original twenty-five in each of the four groups proved to be well-advised. Over the two-year period of study it became necessary to substitute nine preselected couples to replace losses from Groups A and C, and three preselected couples to replace losses from Groups B and D. In summary the study terminated with the following number of subjects:

	GROUPS A	C	GROUPS B	D
Originals surviving	16	15	22	18
Substitutions	9	10	3	7
Total preselected	25	25	25	25

The substitutions for attrition did not change the sex proportions in the study which remained as follows:

Proportion Girls Experimental Groups		Proportion Girls Control Groups	
A	.08	C	.08
B	.36	D	.36
A & B	.22	C & D	.22

There was a slight tendency for younger subjects to be lost and for means to rise slightly with substitutions. The charts in Appendix C, however, show that differences in mean ages, achievement test scores, and WISC IQ's resulting from substitutions were very small.

Equality of the groups at the beginning of the study was established by meeting the conditions originally set forth (a) as to sex proportions, as shown in Appendix ., (b) as to age distributions as shown in Appendix E, (c) as to scholastic achievement test (GVR) scores as shown in Appendix F, and (d) as to WISC full scale IQ distributions as shown in Appendix G.

Because of the necessary substitutions to replace lost couples, it

seemed appropriate to utilize analysis of variance for ages, scholastic achievement, and intelligence of the final groups to determine if the final 100 survivors were prematched groups. This information is shown in detail in Appendices H, I, and J, and in summary in Table 1. It is warranted to conclude that the experimental and control subjects were prematched at the beginning of the study, in factors prescribed. Table 2 describes the experimental (Groups A and B) and the control (Groups C and D) subjects after substitutions were made. Table 3 gives a pre-test description of the four groups after substitutions were made.

Table 1. Initial similarity of final groups determined by analysis of variance for ages, achievement, and intelligence.

Criteria	Source of variance	df	Sum sq's	variance	ob F	P
Age	Between groups	3	60.27	20.09	1.80*	<.20
	Within groups	96	1072.64	11.17		
	Total		1132.91			
Achievement	Between groups	3	387.14	129.05	.58*	<.20
	Within groups	96	21357.86	222.48		
	Total		21745.00			
Intelligence	Between groups	3	109.28	36.43	.24*	<.20
	Within groups	96	14504.88	151.09		
	Total		14614.16			

*Since the observed F in each instance is less than the .20 level of significance (two-tailed test), no significant differences appear to exist between groups combined in any arrangement of pairs as regards age, achievement test scores, or WISC full-scale IQ's. The .20 level of significance was used as a conservative measure because of the need to adjust the groups to equal status as nearly as possible rather than to significantly different status.

Table 2. Description of experimental and control subjects at beginning of the study after substitutions were made.

Experimental subjects (Groups A & B)		Control subjects (Groups C & D)
Number	50	50
Sex	38 boys, 12 girls	39 boys, 11 girls
Mean C.A.	9.61 yrs.	9.92 yrs.
Mean Ed. age	8.00 yrs.	8.14 yrs.
Mean Ed. grade	2.90	3.04
Mean scholastic achievement test average	24.57	26.50
Mean WISC full-scale IQ	93.72	92.84
Mean learning rate	.83	.82

Table 3. Description of the four groups of experimental and control subjects at beginning of the study after substitutions were made.

GROUPS	A	B	C	D
Number	25	25	25	25
Sex	4 girls, 21 boys	8 girls, 17 boys	3 girls, 22 boys	8 girls, 17 boys
Mean C.A.	9.94	9.28	10.30	9.54
Mean Ed. age	8.15	7.86	8.27	8.02
Mean Ed. grade	3.05	2.75	3.15	2.92
Mean scholastic achievement test average	26.50	22.64	27.97	25.02
Mean, WISC full-scale IQ	95.00	92.44	92.44	93.24
Mean, learning rate	.82	.85	.80	.84

Procedures with control subjects. The children in Groups C and D were enrolled in special education classes for "Minimally Brain-injured (MBI)" pupils as authorized by the Texas Education Agency, Division of Special Education (TEA, 1963). The state agency defined them as

> Children who are normal and/or above in intelligence but who have academic difficulties with evidences of minimal brain-injury, poor motor skills, and are unable to adjust to or profit from a regular school program.....

The purpose of the program in which they were enrolled was stated as follows:

> To provide an instructional program in an educational setting that will meet the needs of individual children with minimal brain-injury by assisting them to function educationally and emotionally in such a way that they will be prepared to return either to the regular program or a special class program.

No child was lost from Group C or D during the two-year study because he was returned to a regular classroom or to another type of special class.

The information used by the school to determine a child's eligibility for the special education class was as follows: Chronological age of six years on September 1 and under eighteen years on that date, normal or above intelligence reported in a written psychological report, general physical evaluation, a neurological evaluation, and a signed statement from parent(s) indicating their willingness to participate in the program as set forth in the local plan.

The formula used for the state agency's allocating, and continuing an MBI unit was that there be a minimum number of eight children for one teacher, fourteen for two teachers, and ten for each unit above two teachers. Final initial approval of a unit required that there be a properly certified teacher on the school's official personnel roster.

The instructional program for these special education classes was spelled out in the state agency's guidelines (TEA, 1963) as follows:

> The instructional program shall be based on approved methods of instruction suited to the needs of the child, stressing depth in perceptual area and individuality of instruction in kinesthetic, sensory and academic areas. Teaching methods adapted to this program are those advocated by Fernald (1963)*, Strauss and Lehtinen (1947), Cruickshank (1961), Kephart (1960), Montessori (1914), McGinnis (1963), Myklebust (1954, 1955), Gallagher (1960), Gillingham (1960), and Barry (1961).

*Bibliographical references added by this writer.

The school districts involved were told in the guidelines to "be prepared to allow" in the financial budget "two to three times as much per child for operating a special class as for operating a regular class." Local boards of education were instructed to set up operating budgets "sufficient to establish and maintain the necessary equipment, supplies, and materials to support the instructional program adopted" for these special classes (TEA, 1965).

The teachers employed by the public schools to teach the special classes for the "minimally brain-injured" were required to be "fully certified in the area of the orthopedically handicapped." Standards for teacher education in this area were as follows (TEA, 1965):

1. Content courses required for teachers in elementary schools.

2. Directed teaching in the special area and in the regular classroom.

3. The twelve semester hours in specialized professional preparation required for all teachers in the elementary schools.

4. Three semester hours in a survey course in education for exceptional children.

5. Nine semester hours directly related to teaching physically handicapped children.

The subjects in Groups C and D of this study attended special education classes (MBI) in six different independent school districts located in four Texas cities as follows:

ISD	CITY	No. in GROUP C	No. in GROUP D
Galena Park	Galena Park, Texas	7	9
Harlandale	San Antonio, Texas	8	4
Northside	San Antonio, Texas	2	2
Alamo Heights	San Antonio, Texas	3	6
Austin	Austin, Texas	3	1
Brownwood	Brownwood, Texas	2	3
		25	25

The MBI programs were well established, staffed by certified teachers, and adequately and specially housed, equipped, and supplied.

The teachers of the special education classes knew that certain of their pupils were being used as subjects for special study, and that their intelligence and scholastic achievement were being pre-tested and would be post-tested for comparison with others who were receiving a different type of educational treatment. The testing of the control subjects was done in the child's school, under the direction of the school principal and the supervision of the school psychologist or counselor. The tests were administered by a team of testers trained at the project center for uniformity of administration to all subjects in the study.

Prior to being selected for the study, all control subjects had had neurological evaluations as a requirement for their school placement. The parent(s) of each potential control subject was contacted at the beginning of the study to determine whether or not the physician had prescribed medication as a regular part of the child's treatment. If the answer was affirmative the physician and pharmacist were contacted to determine if the medication was an anticonvulsant. If it was and if the child was selected as a subject in Group C the parents were then told the importance of administering the medication regularly. Medically prescribed medication was purchased by the project for several children whose parents could not afford to pay for it. The parents of all subjects in Group C were notified of this service. Those selected as potential subjects for Group D were children whose parents reported that no medication had been prescribed as regular treatment and that none was contemplated.

Procedures with experimental subjects. To obtain Groups A and B the screened population of potential subjects who met the seven criteria for inclusion in the study (see p. 8) were screened again to discover those who were currently enrolled in regular (not special education) classes in their respective schools. From perusal of the geographical location of the homes and schools of those who survived this second screening, it was decided to locate the centers for after-school clinical teaching in three cities - Brownwood, San Antonio, and San Marcos - since (a) most of the children could commute to one of these centers for daily therapy without undue hardship, (b) physical facilities were readily available for the clinical program, and (c) trained clinical teachers working under supervision of the project directors were available in these cities.

The subjects in Groups A and B of the study were enrolled, and participated in all activities, in regular classes in ten different independent school districts located in five Texas cities, and received daily individualized teaching in the three clinical centers as follows:

ISD	HOME CITY	CLINIC CENTER	No. in GROUP A	No. in GROUP B
San Antonio	San Antonio	San Antonio	9	9
Randolph	San Antonio	San Antonio	1	0
Northside	San Antonio	San Antonio	0	1
Northeast	San Antonio	San Antonio	0	1
Harlandale	San Antonio	San Antonio	0	1
Alamo Heights	San Antonio	San Antonio	0	2
San Marcos	San Marcos	San Marcos	8	5
New Braunfels	New Braunfels	San Marcos	3	2
Luling	Luling	San Marcos	1	1
Brownwood	Brownwood	Brownwood	3	3
			25	25

The parents of all subjects selected for Groups A and B were interviewed. The purpose of the program was explained to them as being an effort to make it possible for their children to compete academically with classmates in the regular classroom. They were told the necessity

of each child's receiving approximately nine hours per week of individual teaching supplementary to, not incorporated within, the regular school day. It was explained (a) that all absences would have to be made-up on Saturdays and other holidays within the first month after the child's return to the regular classroom, and (b) that any child who could not meet these attendance requirements would be dropped from the therapy program and consequently from the study. The parents were instructed not to enter a child into the program if there was high probability of the family's having to change city of residence within the two-year period of the study.

Explaining and conferring at length with parents prior to the final "fixing" of subjects in Groups A and B proved to be worthwhile for insuring attendance at therapy sessions, and reducing loss of subjects for avoidable causes. Reasons for loss of the twelve experimental subjects after pairs had been initially fixed were as follows:

CAUSE OF LOSS	GROUP A	GROUP B
Family moved residence		
by military order	1	1
for father's employment	1	2
parents divorced	4	
Child dropped for excessive absences		
due to illness	1	
parents' convenience	1	
Little League baseball practices	1	
Total number lost and replaced	9	3

The following criteria were set-up for all clinical teachers administering the supplementary individualized educational therapy:

1. A graduate or senior student at, or a recent graduate from, Southwest Texas State College, majoring in speech and hearing therapy or in teaching children with language-learning disabilities. This was to insure relative uniformity of professional philosophy, procedures, and communication with the project directors.

2. Certified, or in the process of obtaining within the year state certification (authorized by Southwest Texas State College), as a speech and hearing therapist, or a teacher of the "orthopedically handicapped." This was to insure adequate professional preparation for administering the clinical teaching.

3. Certified by the State of Texas, or eligible within the year for certification, as a regular elementary classroom teacher of grades one through eight. This was to insure familiarity with the content material and academic procedures in which the child was expected to participate and achieve during the school day.

4. Semester hours of college credit in the related areas of (a) normal development of language in children, (b) patho-

ologies of language and their treatment, (c) child psychology, and (d) mental health and personal adjustment. This was to insure a broad base for understanding the child, his parents, and their problems, and for establishing a satisfactory interpersonal relationship with the child.

5. At least fifty previous supervised clock hours in therapy with children with learning-language disabilities. This was to insure that the teacher could evaluate progress, report promptly and efficiently in writing to the project directors, and plan effectively for each clinical session.

6. Personal aptitude, previously manifested in supervised clinical practice, for adapting methods and materials on the basis of diagnosis and school curriculum. This was to insure that the clinical teacher would not administer "a method" presumed to be effective with all children, but would adapt procedures towards the goal of the child's accomplishing classroom assignments.

Five children for individualized teaching was considered a full-load for a clinical teacher. The stipend provided in the project budget for such teaching was minimal. The children from Groups A and B were available for supplementary teaching only in the mid- and late afternoons and on Saturdays.

The greatest problem encountered during the project was that of securing clinical teachers who met the qualifying criteria and who could adjust their work and study schedules for participation. It was apparent from the start that few could carry full loads. The project design was altered to meet the inevitable turn-over in clinical teaching personnel, and to provide for many clinicians' carrying partial case-loads. Throughout the two-year study a pool of prospective and substitute clinical teachers was kept prepared and informed of the program, so that continuity of the supplementary, after-school program was never interrupted because of absence or unavailability of a clinical teacher. Instead of the originally proposed ten clinical teachers for the fifty experimental subjects, sixty-one clinical teachers participated during the study. Only two of the sixty-one carried full case-loads throughout the two years, and only four participated in the study from beginning to termination. Principal cause of clinical teachers' leaving the program was college graduation. Table 4 shows the sources from which the clinical teachers were obtained and the time they spent in the study.

Materials used in the clinical teaching sessions were the child's regular classroom textbooks and assignments, including incompleted classwork and home assignments. It was hypothesized that improvement in scholastic achievement could occur at grade placement level without a recapitulation of experiences from lower achievement levels. The clinical teachers were instructed, therefore, not to "proceed at the child's own speed" but to proceed at least at the minimal speed of the child's regular classmates.

Table 4. Clinical teachers employed for supplementary, individualized teaching of subjects in Group A and B.

Academic Classification	Years in Program 2.0	1.5	1.0	0.5	0.25	0.125	Other*	Total
Post-graduate (non-student)	2						9	11
Graduate student	2	4	2	7	9	2		26
Senior student		4	16	4				24
Total	4	8	18	11	9	2	9	61

*Occasional substitutes, on-call but not employed for a sequence of time.

No time was devoted to perceptual, motor-perceptual, or motor-coordination training as such. Since transfer of learning is still a moot question in the psychology and theories of learning the clinical teachers were instructed to avoid any and all procedures reputed to alter the neurological organization of the child, and to devote all time and energies toward teaching classroom assignments by any method which seemed functional for that particular child.

Using the classroom textbooks and assignments as materials, the clinical sessions were devoted entirely to teaching the experimental subjects basic language skills, namely: speech, understanding of speech, reading, written spelling and composition, and arithmetic. The rationale for this procedure was based upon two concepts about normal and disordered language. The first concept concerned the nature of language; namely, that language is not meaning, but a learned conventional code--not the message, but the code that communicates the message (Fries, 1952). In the clinical teaching program, therefore, the clinician attempted to discover and correct the errors each child had made in learning the code of language.

The second concept which formed the framework for the clinical teaching was that, while five modalities of language were recognized-listening, speaking, reading, writing, and numerical computation and reasoning - a disorder of language was not modality specific (Schuell, 1964). Although the presenting complaint of all the subjects was scholastic underachievement, all had a general deficit crossing all language modalities. All had reduction of available vocabulary and impaired verbal retention span. All were impaired in their perception and production of oral as well as written language.

None of the subjects were competent in reading, written spelling and composition, or arithmetic computation and reasoning. Had they been they would not have qualified for inclusion in the study. The source of their errors in the language code could be detected, however, by close attention to their production of and response to speech in which, without exception, they manifested breakdown in one or more of the four elements of all natural languages - phonemes, morphemes, phases, and/or sentences (Schuell, 1964). It is likely that the success of speech pathology students as clinical teachers derived from their ability to detect, diagnose, and prescribe treatment for breakdowns in these linguistic elements.

Representative errors discovered in the oral-auditory language of subjects in Groups A and B, and some of the methods used to circumvent them were as follows:

1. Phonemes were disarranged, e.g., "aminals" for animals, "pinano" for piano, and "priestopal" for episcopal. These children were always very poor spellers. In therapy they were taught first to say the words correctly, and then to talk simultaneously as they wrote the words.

2. Morphemes were confused, e.g., "womans" for women, "fighted" for fought, and "table sticks" for table legs. These children

always found grammar extremely difficult. They were carefully taught the various morphemes in controlled, structured lessons, using the materials from the regular classroom texts.

3. Phrases were out of their designated relationships in the English code, e.g., "Hold the umbrella under you and walk over it for to keep you dry." These children misunderstood connected utterances which they heard, and were rarely able to follow oral or written instructions. They were taught to "shadow talk" with the speaker, and to "reauditorize" (Johnson and Myklebust, 1967) by self-talk to improve their retention and recall.

4. They produced sentences which conformed to no permissible structure in the English code, e.g., "A hat is something what's when it's real windy and you got ear to hurts and heads cold you put some hats on and it won't." These children found written composition impossible until they were taught to produce oral sentences in structured keys or frames (Fries, 1952, and Fitzgerald, 1949). Then they were taught to write and read the oral sentences they had spoken (Fernald, 1943). The material talked about and subsequently written, however, always pertained to subject matter under study in their regular classroom at school.

5. They confused words with similar sound and/or letter configurations, e.g., dime and diamond, and stable and fable. These children were the poorest of readers. The clinical teachers took time in therapy sessions to carefully and thoroughly teach these children the association between English phonemes and letters of the Roman English alphabet (Zedler, 1955).

6. They recalled oral instructions not at all, irrelevantly, or at best incompletely. Furthermore their recall was inconsistent, in that "one day they knew the information and the next day they did not." These children could usually correctly select from multiple choices what they could not recall in response to a direct question. The clinical teachers always gave these subjects multiple choice questions on classroom subject matter. Later the children were taught to devise possible multiple choices for themselves when they were seeking correct responses.

7. They had difficulty recalling names of familiar objects. Their vocabularies abounded with vague categorical names such as "thingamajig", "deal", and "something", which they used in the place of specific names and terms. The clinical teachers kept a record of the names each child found difficult, and gave him opportunity during therapy sessions to use the correct terms repeatedly.

8. Arithmetic presented many difficulties which varied from child to child. Some were unable to understand sequences,

position in space, or temporal concepts. Others could compute but could not break the code of stated problems, e.g., At 7¢ each what will be the cost of three apples? was interpreted and repeated by one child as "If you each have 7¢ how many apples did you buy?" The clinical teacher diagnosed the source of difficulty with numerical concepts and used various methods to circumvent it. Speed, memorization, and drill were never used and were always deemphasized in therapy sessions (Orton, 1937).

It is not within the scope of this report to describe and discuss methodology used in the clinical sessions with the subjects in Groups A and B of the study. The above illustrations have been given to show that the procedures were highly individualized and required a well-trained and proficient clinician to carry them out. Each clinical teacher described in writing the procedures and results of each therapy session and submitted them each week to the assistant investigator along with plans for the next week's clinical sessions. The assistant investigator and the project director were always available for conference regarding difficulties encountered in clinical sessions.

The classroom teachers of the children in Groups A and B were not apprised of the research design. They were told that the children were being "tutored" in an attempt to alleviate underachievement in academic subjects. They were asked to report to the "tutor" as to (a) the areas of subject matter in which the child needed to improve, and (b) the classroom assignments as anticipated for an entire week.

The matter of keeping track of assignments presented a major problem early in the study. Classroom teachers wrote the assignments on the chalkboard and/or announced them orally. The children in the study either could not, or failed to, copy the assignments correctly, or they misunderstood and/or forgot what had been orally announced. This problem was solved by the project director's preparing assignment booklets for an entire month; supplying each child's parent with three copies of a booklet; and charging the parent with the responsibility for securing the weekly assignments, leaving one booklet with the classroom teacher, entering the assignments in a booklet which was kept at home, and copying the assignments into the third booklet which was passed on to the clinical teacher. The parents welcomed this responsibility as being a fair exchange for the hours of "homework" which they had previously tried to do with their underachieving children. Very few of the parents failed to keep the clinical teacher supplied with the assignments.

Unlike the control subjects, all of whom had previously had general physical and neurological examinations by physicians as requirements for their placement in the special education classes in school, the experimental subjects had to have their physical and neurological evaluations at the beginning and as a part of the study to insure their meeting all of the seven criteria for inclusion. This gave the project director opportunity to inquire of the physicians concerned (pediatrician and neurologist) whether or not anticonvulsive medication would or would not be prescribed as a regular part of the child's treatment. The physicians were aware of the research design. They assisted the investigators in forming two

pools of potential subjects for Group A (medicated) and Group B (unmedicated).

After the subjects were selected for Group A the parents of these children were counseled, as were the parents in control Group C, as to (a) the importance of administering the prescribed medication regularly, and (b) the availability of project funds for purchase of the medication. As with the parents of subjects in Group C (control and medicated) the parents of subjects in Group A (experimental and medicated) were charged with the responsibility of securing and administering the anticonvulsive medication.

The precaution of maintaining the same treatment for reserves needed for substitutions was carefully observed throughout the study. The reserves received the same treatment as the original twenty-five subjects selected for each group. The clinical teachers of experimental subjects were never aware of the composition of the specific Groups A and B, or the reserve pools. They were not apprised of which children were receiving anticonvulsive medication and which were not. When a subject was lost from the study the project director notified the statistician and he made the substitution on paper from the reserve pool, all of whom had been receiving the same clinical teaching as the original fifty subjects in Groups A and B.

Post-testing. In the late spring of the 1965-1966 school year at the close of the two-year study, the 100 experimental and control subjects in Groups A, B, C, and D were retested with the WISC (Wechsler, 1949) and The General Achievement Test (Gray, Votaw, Rogers, 1962) to determine the following:

1. whether or not statistically significant changes had arisen in the mental functioning and scholastic achievement of the experimental subjects (Groups A and B) who had remained in regular classrooms and received supplementary, individualized clinical teaching after school,

2. whether or not statistically significant changes had also occurred in the mental functioning and scholastic achievement of the control subjects (Groups C and D) who had been enrolled in special education classes for the "minimally brain-injured" and had not received the supplementary clinical teaching provided in this study,

3. whether or not there were statistically significant differences between gains in mental functioning and scholastic achievement of the experimental subjects (Groups A and B) and gains of the control subjects (Groups C and D), and

4. whether or not there were statistically significant differences between the gains in mental functioning and scholastic achievement of the subjects who received the anticonvulsive medication (Groups A and C) and those who did not (Groups B and D).

RESULTS AND FINDINGS

The data obtained from the pre- and post-testing was analyzed to compare changes within the 100 subjects; within each of the four Groups, A, B, C, and D; and in mental functioning and scholastic achievement between the following arrangements of subjects:

Groups A and B (experimental medicated, and experimental unmedicated)
Groups A and C (experimental medicated, and control medicated)
Groups B and D (experimental unmedicated, and control unmedicated)
Groups C and D (control medicated, and control unmedicated)
Groups A and B, and Groups C and D (all experimentals and all controls).

Table 5 summarizes the means and standard deviations of the various measures.

Comparisons for significance of pre- and post-test differences between the groups were done manually and by computor. A summary of the manually derived t tests for significance is given in Table 6. The detailed data upon which Table 6 is based may be found in Appendices K through X. A summary of significance of differences derived by computor between all experimental (Groups A and B) and all control (Groups C and D), and between all medicated (Groups A and C) and all unmedicated (Groups B and D) subjects on gain in scholastic achievement and mental functioning is shown in Table 7. The detailed t and Chi squares derived by computor analysis, upon which Table 7 is based, may be found in Appendices Y and Z (Hays, 1964).

As Appendices L, N, P, R, T, V, and X show there were no significant changes in variability of gain scores in any of the groups compared on any of the measures. This general lack of significant changes in variability is noteworthy, for it shows that even though the mean gain for one group was significantly greater than the mean gain for another, the variability for the two groups remained much the same.

As Tables 6 and 7 show all of the experimental subjects (Groups A and B) made significantly higher gains than all the control subjects (Groups C and D) in scholastic achievement, and in WISC full-scale and verbal IQ's, at or beyond the .05 level of confidence, by test scores obtained manually and by computor. These tables also show that the subgroups of experimental subjects, whether medicated (Group A) or unmedicated (Group B), made significantly ($p<.05$) greater gains in total average scholastic achievement, Educational Age, Educational Grade, and WISC full-scale and verbal IQ's than did the subgroups of control subjects whether medicated (Group C) or unmedicated (Group D). These findings clearly support the first hypothesis (See page 7); namely, that the experimental subjects (Groups A and B) would make significantly greater gains, in academic achievement and in mental functioning, than the control subjects (Groups C and D).

Table 5. Means and standard deviations of pre- and post-measures between and within the various groups.

Measures		Description Groups	All S's	All Exp. A + B	All Con. C + D	All Med. A + C	All Unmed. B + D	Exp. Med. A	Exp. Unmed. B	Con. Med. C	Con. Unmed. D
		N	100	50	50	50	50	25	25	25	25
		6-1-66	11.52	11.36	11.67	11.85	11.16	11.69	11.03	12.05	11.29
Chro. Age		9-1-64	9.77	9.61	9.92	10.12	9.41	9.94	9.28	10.30	9.54
		Gain	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75
		Post	9.42	9.66	9.18	9.51	9.33	9.80	9.52	9.21	9.14
Educ.* Age		Pre	8.07	8.00	8.14	8.21	7.94	8.15	7.86	8.27	8.02
		Gain	1.35	1.66	1.04	1.30	1.39	1.65	1.66	.94	1.12
		Post	4.31	4.55	4.07	4.40	4.22	4.69	4.42	4.10	4.03
Educ.* Grade		Pre	2.97	2.90	3.04	3.10	2.84	3.05	2.75	3.15	2.93
		Gain	1.34	1.65	1.03	1.30	1.38	1.64	1.67	.95	1.10
		Post	40.09	42.42	37.76	40.99	39.19	43.93	40.91	38.04	37.46
G V R	Tot. Ave. **	Pre	25.53	24.57	26.50	27.24	23.83	26.50	22.64	27.97	25.02
		Gain	14.56	17.85	11.26	13.75	15.36	17.43	18.27	10.07	12.44
		SD	7.64	7.14	6.59	7.29	7.86	6.94	7.31	5.56	7.29
		Post	38.54	40.01	37.07	38.56	38.52	40.84	39.18	36.28	37.86
G e n	Read.	Pre	24.65	23.61	25.69	25.79	23.51	24.84	22.38	26.74	24.64
		Gain	13.89	16.40	11.38	12.77	15.01	16.00	16.80	9.54	13.22
		SD_G	9.20	8.22	9.44	8.44	9.41	8.47	7.69	8.00	10.37
		Post	39.41	40.80	38.02	39.22	39.60	40.28	41.32	38.16	37.88
A		Pre	24.71	23.34	26.08	26.36	23.06	24.32	22.36	28.40	23.76
c	Spell.	Gain	14.70	17.46	11.94	12.86	16.54	15.96	18.96	9.76	14.12
h		SD_G	10.87	11.13	9.85	11.12	10.28	11.46	10.58	10.23	9.38
		Post	40.39	42.97	37.81	42.22	38.56	45.72	40.22	38.72	36.90
T	Arith.	Pre	25.50	24.61	26.39	27.33	23.67	26.68	22.54	27.98	24.80
e		Gain	14.87	18.36	11.42	14.89	14.89	19.04	17.68	10.74	12.10
s		SD_G	8.99	7.58	8.96	8.83	9.16	7.12	7.95	8.41	9.43
		Post	93.26	95.94	90.58	92.24	94.28	95.60	96.28	88.88	92.28
W	Full Scale IQ	Pre	93.28	93.72	92.84	93.72	92.84	95.00	92.44	92.44	93.24
		Gain	-.02	+2.22	-2.26	-1.48	+1.44	+.60	+3.84	-3.56	-.96
		SD_G	7.26	6.89	6.93	7.69	6.49	7.36	5.95	7.45	6.10
		Post	93.36	96.24	90.48	91.40	95.32	95.12	97.36	87.68	93.28
I	Verbal Scale IQ	Pre	94.26	94.34	94.18	94.32	94.20	94.60	94.08	94.04	94.32
		Gain	-.90	+1.90	-3.70	-2.92	+1.12	+.52	+3.28	-6.36	-1.04
		SD_G	7.89	7.14	7.64	7.98	7.29	6.72	7.29	7.65	6.63
		Post	94.29	96.30	92.28	94.44	94.14	96.80	95.80	92.08	92.48
S	Per-form. Scale	Pre	93.66	94.48	92.84	94.40	92.92	96.60	92.36	92.20	93.48
		Gain	+.63	+1.82	-.56	+.04	+1.22	+.20	+3.44	-.12	-1.00
C	IQ	SD_G	10.00	9.90	9.96	10.98	8.80	10.87	8.52	11.18	8.54

*The Educational Age and the Educational Grade are merely additional calibrations of the test-score scale. Significance results for their gains, therefore, are the same as for those of score gains.

**Total-Average scores in two of the three test levels involve ten subtests, whereas Reading, Spelling, and Arithmetic involve only five subtests. Therefore, a Total-Average mean may not be the sum of the three subscore means.

Table 6. Summary of significance of differences by t test between the groups on pre- and post-testing of scholastic achievement (GVR) and mental functioning (WISC).

Group	Description	N	Scholastic Achievement: Total Average	Total Reading	Spelling	Total Arithmetic	Mental Functioning: Full Scale IQ	Verbal Scale IQ	Perform. Scale IQ
A + B	All Exp.	50	*	*	*	*	*	*	
C + D	All Con.	50							
A + C	All Med.	50							
B + D	None Med.	50			*		*	*	
A	Exp. Med.	25	*	*	*	*	*	*	
C	Con. Med.	25							
B	Exp. Not Med	25	*			*	*	*	*
D	Con. Not Med.	25							
A	Exp. Med.	25							
B	Exp. Not Med.	25							
C	Con. Med.	25							
D	Con. Not Med.	25						*	

* significant at or beyond the .05 level of confidence.

NOTE: The positions of the * indicates the group which made significantly greater gain than the group with which it is compared.

Table 7. Summary of significance of differences between all experimental and all control and between all medicated and all unmedicated subjects on pre- and post-testing of scholastic achievement (GVR) and mental functioning (WISC) using computor derived Chi Square and Student *t* tests

		Scholastic Achievement					
Group Description	N	Total Average	Total Reading	Spelling	Total Arithmetic	Edu. Age	Edu. Grade
A + B All Exp.	50	* & **	* & **	*	* & **	* & **	* & **
C + D All Con.	50						
A + C All Med.	50						
B + D None Med.	50						

		Mental Functioning		
Group Description	N	Full Scale IQ	Verbal Scale IQ	Performance Scale IQ
A + B All Exp.		* & **	*	
C + D All Con.				
A + C All Med.				
B + D None Med.		*	*	

* *t* is significant at or beyond the .05 level of confidence.

**Chi sq. is significant at or beyond the .05 level of confidence.

NOTE: The positions of * and ** indicate the group which made significantly greater gain than the group with which it is compared.

The second hypothesis, relative to medication (See page 7), was not supported by statistical analyses. As may be seen in Tables 6 and 7, the difference in mean gains on scholastic achievement made by the combined medicated groups (A and C) and by the combined unmedicated groups (B and D) were not significant. There was a tendency to favor the unmedicated groups, since on the manually derived t scores (See Table 6), the combined unmedicated groups (B and D) made significantly greater gain ($P<.05$) in spelling than did the combined medicated groups (A and C). When the gains in scholastic achievement of Group A (exp. med.) were compared with Group B (exp. unmed.), and Group C (con. med.) with Group D (con. unmed.) there were no significant differences.

Tables 6 and 7 report significant differences ($p<.05$) in gain on WISC full-scale and verbal IQ's favoring the combined unmedicated groups (B and D) over the combined medicated groups (A and C). As Table 6 shows, when Group A (exp. med.) was compared with Group B (exp. unmed.) on WISC IQ changes there were no significant differences. However, the difference between Group D (con. unmed.) and Group C (con. med.) on WISC Verbal IQ was significant ($p<.05$) and favored unmedicated Group D.

As Table 5 reports, while the WISC full-scale IQ mean held almost exactly constant for the one hundred subjects from pre-test (93.28) to post-test (93.26), it increased for the fifty experimental subjects (Groups A + B) and decreased for the fifty control subjects (Groups C + D). The result was a highly significant difference ($p<.01$) between these two groups, as shown in Appendices S and Y and Tables 6 and 7. These data supported the hypothesis that upon retest there would be significantly greater gains in mental functioning for the experimental subjects (A + B) than for the control subjects (C + D).

It seemed important to analyze the data for significance of each group's mean gain or loss in WISC full-scale IQ between pre- and post-testing. As seen in Table 8 there were significant gains ($p<.05$) in WISC full-scale IQ's for the fifty experimental subjects (Groups A + B) and for the twenty-five unmedicated experimental subjects (Group B). Table 8 also reports significant losses ($p<.05$) in WISC full-scale IQ's for the fifty control subjects (Groups C + D) and for the twenty-five medicated control subjects (Group C). This analysis of the data reports that between initial and final testing statistically significant ($p<.05$) positive changes in mental functioning arose within the experimental group (A + B) but that statistically significant ($p<.05$) negative changes in the same variable arose within the control group (C + D).

Reliability coefficients were computed between pre- and post-test WISC full-scale IQ's for the four groups (A, B, C, and D). Inspection of Table 9 shows that in all cases the reliability coefficients were acceptable.

To further investigate the changes in IQ that had taken place between the initial and final testings, it was decided to find the proportion of subjects in each group who had made significant changes (gains or losses) in WISC verbal, performance, and full-scale IQ's. Table 10 reports these proportions.

Table 8. Significance of group changes in WISC full-scale IQ's between initial and final testings

Group Description	N	Σd^2	S_d	$S_{(\bar{x}_1 - \bar{x}_2)}$	Gain	df	ob t
A + B All Exp.	50	2370.58	6.95	.98	+2.22	49	2.27 Gain*
C + D All Con.	50	2403.62	7.00	.99	-2.26	49	2.28 Loss*
A + C All Med.	50	2958.48	7.77	1.10	-1.48	49	1.35 Loss
B + D None Med.	50	2104.32	6.55	.93	+1.44	49	1.56 Gain
A Exp. Med.	25	1354.00	7.51	1.502	+ .60	24	.40 Gain
B Exp. Not Med.	25	885.36	6.07	1.214	+3.84	24	3.17 Gain*
C Con. Med.	25	1388.16	7.61	1.522	-3.56	24	2.34 Loss*
D Con. Not Med.	25	930.96	6.23	1.246	- .96	24	.77 Loss

*p is significant at the .05 level of confidence.

NOTE: Total change for the 100 subjects between WISC pre-test full-scale and post-test full-scale was -.02, which of course, is no change.

Table 9. Correlation of pre-test WISC full-scale IQ's and post-test WISC full-scale IQ's for each group.

Group	Description	N	Pearson Product - moment coefficient of correlation
A	Exp. Med.	25	+ .885
B	Exp. Not Med.	25	+ .887
C	Con. Med.	25	+ .752
D	Con. Not. Med.	25	+ .848

Table 10. Comparison of proportions of subjects in each group who made changes in WISC IQ's from pre-test to post-test.

Group	Description	N	Proportion of Significant*					
			Gains			Losses		
			Verb.	Perf.	F-S	Verb.	Perf.	F-S
A + B	All Exp.	50	.32	.26	.22	.14	.10	.08
C + D	All Con.	50	.12	.18	.16	.38	.20	.30
A + C	All Med.	50	.16	.24	.20	.34	.18	.26
B + D	None Med.	50	.28	.20	.18	.18	.12	.12
A	Exp. Med.	25	.24	.24	.20	.16	.12	.12
B	Exp. Not Med.	25	.40	.28	.24	.12	.08	.04
C	Con. Med.	25	.08	.24	.20	.52	.24	.40
D	Con. Not Med.	25	.16	.12	.12	.24	.16	.20

*p is significant at the .05 level of confidence.

NOTE: A deviation of the post-test IQ from the pre-test IQ amounting to at least two SE_m provides a .05 level of confidence that the deviation was not due to chance (Wechsler, 1949, pp. 13-14).

As may be seen in Table 5, all groups and combinations of groups (A + B, C + D, B + D, A, B, C, and D) made positive gains in all aspects of scholastic achievement. As shown in Table 6 and Appendix K, however, the experimental groups (A + B, A, and B) made significantly greater gains ($p < .01$) in total-average achievement than did the control groups (C + D), C, and D). It seemed important to compare the extent of scholastic achievement gain, made by each group, with normal gain. This was accomplished by comparing each group's mean Educational Grade-gain on the total-average GVR General Achievement Test with the normal grade-gain of 1.85 which would be expected of pupils in regular classrooms upon retesting after two school years (Gray, Votaw, Rogers, 1962, p. 7 of manual). Table 11 reports these findings. While no group achieved normal gain, all of the experimental groups (A + B, A, and B) approached it closely.

Before conclusions could be drawn as to the role played by the dependent variable of educational management it was necessary to investigate, for significance of difference, the mean scholastic achievement scores of male and female subjects in each group. Table 12 shows no evidence that either sex made better gains in scholastic achievement than the other whether in the experimental half, the control half, or the total pool. Table 13 reports no evidence that the gain-scores in scholastic achievement were more variable for one sex than for the other; however, it is noticeable that the males in the control group exceeded the females in that group in variability by an amount which almost reached the .05 level of significance.

Appendices AA, BB, CC, and DD report Student t and Chi sq. scores obtained by computor in comparing GVR and WISC gains made by males with those made by females in the experimental group (A + B), the control group (C + D), the medicated group (A + C), and the unmedicated group (B + D). There were no significant differences.

Table 11. Comparison between Educational Grade-gains made by groups and normal grade-gains on total-average GVR Achievement Test

Group	Description	N	Mean Educational Grade Posttest	Pretest	Gain	Normal Grade Gain*	Ratio
	All Subjects	100	4.31	2.97	1.34	1.85	.72
A + B	All Exp.	50	4.55	2.90	1.65	1.85	.89
C + D	All Con.	50	4.07	3.04	1.03	1.85	.56
A + C	All Med.	50	4.40	3.10	1.30	1.85	.70
B + D	None Med.	50	4.22	2.84	1.38	1.85	.75
A	Exp. Med.	25	4.69	3.05	1.64	1.85	.89
C	Con. Med.	25	4.10	3.15	.95	1.85	.51
B	Exp. Not Med.	25	4.42	2.75	1.67	1.85	.90
D	Con. Not Med.	25	4.03	2.93	1.10	1.85	.59
A	Exp. Med.	25	4.69	3.05	1.64	1.85	.89
B	Exp. Not Med.	25	4.42	2.75	1.67	1.85	.90
C	Con. Med.	25	4.10	3.15	.95	1.85	.51
D	Con. Not Med.	25	4.03	2.93	1.10	1.85	.59

*See GVR Manual, 1962, p. 7.

NOTE: Significance of differences between groups are the same as those indicated in Appendix K and Table 6.

Table 12. Comparisons of means of total-average achievement test gain-scores of male and female subjects

Group	Sex	N	M	SD^2	Dif_M	df	ob. t
All Subjects	M	77	14.700	61.94	.639	98	.35*
	F	23	14.061	44.22			
Exp. Subjects (A + B)	M	38	17.776	59.44	.307	48	.12*
	F	12	18.083	37.45			
Con. Subjects (C + D)	M	39	11.703	50.69	2.030	48	.89*
	F	11	9.673	14.75			

*p is not significant at .20 level of confidence

NOTE: The two-tailed test of significance applies here, since no hypothesis as to direction of differences between means is imposed.

Table 13. Comparison of variabilities of total-average achievement test gain-scores of male and female subjects.

Groups	Sex	N	SD	SD^2	Dif SD	df	ob. F
All Subjects	M	27	7.87	61.94	1.22	76,22	1.36*
	F	23	6.65	44.22			
Exp. Subjects (A + B)	M	38	7.71	59.44	1.59	37,11	1.49*
	F	12	6.12	37.45			
Con. Subjects (C + D)	M	39	7.12	50.69	3.29	38,10	3.21**
	F	11	3.84	14.75			

*Not significant at the .20 level of confidence.
**Not significant at the .05 level of confidence.

NOTE: The two-tailed test of significance applies here, since no hypothesis as to direction of differences between standard deviation is imposed.

The data were analyzed manually and by computor to determine the role IQ might have played in the scholastic achievement of the subjects. In Tables 14, 15 and 16 Pearson Product Moment coefficients of correlation were computed and compared with Rho, or the population coefficient, to determine significance of relationship between total-average gain-scores and WISC full-scale, verbal, and performance IQ gain points for all groups. Table 17 reports correlations of WISC full-scale pre- and post IQ's (NOT full scale IQ-gain points as in Table 14) with GVR total-average gain as determined by computor. Table 17 shows that pre- and post full-scale IQ's were highly and positively correlated for the 100 subjects, as would be expected since the pre- and post means differed very little. This table also shows that gain in scholastic achievement is positively correlated with pre-IQ at a low level, but with post-IQ at a higher level. The GVR total-average on the post-test is also positively correlated with pre-IQ and GVR gain at a low level, but with post-IQ at a higher level. The correlations in Tables 14, 15, and 17 show that IQ did play a role in scholastic achievement gain. The role was probably secondary, however, since the correlations were so low.

Table 17 also reports correlation coefficients of chronological age with IQ and GVR total-average gain. The table shows that CA was not correlated with either pre- or post-full-scale IQ. CA was negatively correlated with GVR gain, and positively correlated with GVR total-average on the post test. This means that although, as was to be expected, the older subjects made higher total-average scores on the GVR post test than did the younger subjects, the younger subjects made greater gains between pre- and post-testing than did the older subjects.

Following termination of the study the principle investigator postponed final reporting until ancillary information could be obtained from the schools and from the parents of the one hundred subjects in the study. This information was relative to a) the subjects' having taken or not taken prescribed medication, and b) the school's placement of the subjects following termination of the study. The information was obtained by trained, unbiased social workers not hitherto associated with the study. Since this supplementary information did not lend itself to statistical treatment, it is reported in Appendix EE.

Table 14. Correlation of GVR total-average gain scores and WISC full-scale IQ gain points by groups.

Group	Description	N	df	r	Rho = 0* test
All	Subjects	100	98	+ .234	> .165
A + B	All Exp.	50	48	+ .168	< .236
C + D	All Con.	50	48	+ .061	< .236
A + C	All Med.	50	48	+ .308	> .236
B + D	None Med.	50	48	+ .122	< .236
A	Exp. Med.	25	23	+ .283	< .336
B	Exp. Not Med.	25	23	+ .017	< .336
C	Con. Med.	25	23	+ .114	< .336
D	Con. Not Med.	25	23	- .051	< .336

*NOTE: The correlation, Rho, of the parent population is hypothesized to be zero and r's are determined for samples of sizes indicated to meet the .05 level of significance. The formula used is

$$t = \frac{r\sqrt{N-2}}{\sqrt{1-r^2}}$$ which is solved for r when 1.66 is substituted for t(N = 100), 1.68 for t(N = 50), and 1.71 for t(N = 25).

Table 15. Correlation of GVR total-averages gain scores and WISC verbal IQ gain points by groups

Group Description	N	df	r	Rho = 0* test (.05)
All Subjects	100	98	+ .206	> .165
A + B All Exp.	50	48	+ .252	> .236
C + D All Con.	50	48	- .025	< .236
A + C All Med.	50	48	+ .391	> .236
B + D None Med.	50	48	+ .066	< .236
A Exp Med.	25	23	+ .530	> .336
B Exp. No Med.	25	23	+ .054	< .336
C Con. Med.	25	23	- .027	< .336
D Con. No Med.	25	23	- .159	< .336

*See Note, Table 14.

Table 16. Correlation of GVR total-average gain scores and WISC performance IQ gain points by groups.

Group Description	N	df	r	Rho = 0* test
All Subjects	100	98	+ .103	< .165
A + B All Exp.	50	48	+ .033	< .236
C + D All Con.	50	48	+ .101	< .236
A + C All Med.	50	48	+ .090	< .236
B + D None Med.	50	48	+ .110	< .236
A Exp. Med.	25	23	+ .040	< .336
B Exp. No Med.	25	23	+ .010	< .336
C Con. Med.	25	23	+ .169	< .336
D Con. No Med.	25	23	+ .027	< .336

*See Note, Table 14.

Table 17. Correlations of CA and WISC full-scale IQ with GVR total-average gain*(N = 100).

Correlation Coefficients Times 1000	1 CA (Yrs)	2 Full IQ Pre	3 Full IQ Post	4 GVR Tot-Ave Gain	5 GVR Tot-Ave Post
1 CA (Yrs)	1000				
2 Full IQ Pre	-089	1000			
3 Full IQ Post	-104	817	1000		
4 GVR Tot-Ave Gain	-416	257	399	1000	
5 GVR Tot-Ave Post	665	251	348	218	1000

*NOTE: When Rho = 0, df = 98, and correlations are independent, the probability is approximately .95 that a correlation will lie outside the interval -0.196 to +0.196. Note that these correlations are not independent.

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to investigate a method whereby schools may achieve maximal results with underachieving children who have specific language-learning disorders which are attributable to medically diagnosed neurological impairment, but who are otherwise normal. To make this investigation the study was designed to challenge the procedure of referring such children to special education classes (Texas Education Agency, 1963).

It was hypothesized that such children would make significantly greater gain in academic achievement and mental function if they were not removed from regular classes at any time during the school day, but were given supplementary, individualized instruction by specially trained clinicians outside of regular school hours, than if they were removed from regular classes and taught in special education classes. Results of the study clearly supported this hypothesis.

Although both the experimental and control groups had gained in scholastic achievement at the close of the two-year study, the mean gain in scholastic achievement of the experimental subjects was significantly higher than that of the control subjects, even though both groups had been carefully equated at the start of the investigation. Furthermore, at the close of the study the mean WISC full-scale and verbal IQ's had increased for the experimental subjects and decreased for the control subjects. Although these positive and negative changes in IQ were small the difference between the experimental and control groups on the variable was significant.

Because each of one hundred children (fifty experimental and fifty control) had been medically diagnosed neurologically impaired as a criteria for inclusion in the study, and because the physicians who were consultants to the project were actively involved in seeking effective methods for treating these well children whose presenting complaint was academic underachievement, a second major parameter was investigated. It was hypothesized that subjects in the study would make significantly greater gain in academic achievement and mental function when they took anticonvulsive medication than when they did not. Statistical results did not support this hypothesis.

When compared with those for whom medication had been prescribed irrespective of classroom placement and type of teaching, the subjects for whom medication had not been prescribed made greater gains in WISC full-scale and verbal IQ's. The gains were small and probably within normal limits, but the difference in favor of the unmedicated group was significant. There was no significant difference in total-average scholastic achievement between the medicated and unmedicated subjects.

From the beginning of the study a question arose about the parameter of medication versus nonmedication, relative to the children's consistency in taking the prescribed medication. The medication was not under the control of any one person with authority to require its continuation as started at the beginning of the study or to prevent its administration to those not scheduled in the study to receive it. Did those subjects who were classified as medicated actually take the

medication everyday and in the prescribed amount? Did those classified as not medicated actually not take anticonvulsive medication during the study? Answers to these questions were sought at the close of the study and are reported as ancillary information in Appendix EE. As with all studies involving children who live at home, the giving or withholding of medicine is in the parents' province, and depends upon the parents' volition.

As will be seen in Appendix EE there were a few inconsistencies regarding medication. Most of the parents, however, followed the physicians' original advice so that the majority of the subjects classified as medicated took anticonvulsive medication throughout the two-year period, and the majority classified as unmedicated took none. There is a strong tendency, therefore, to conclude that medication did not influence the scholastic achievement gain of subjects in this study. It should be emphasized that it was not within the province of this study to investigate changes in mood, behavior, or personality, all of which are factors reported in the literature to be favorably changed by anticonvulsive medication (ACNP, 1967).

Results support the following conclusions about the subjects in this two-year study:

1. The fifty who remained in regular classrooms and received supplementary, individualized teaching outside of school hours from specially trained clinicians made significantly greater gain in scholastic achievement than the fifty who were enrolled in special education classes and did not receive the supplementary clinical teaching, although both groups made positive gains.

2. The fifty who remained in the regular classes and received supplementary teaching gained in IQ, while the fifty who were enrolled in special education classes and did not receive the supplementary teaching lost in IQ, and the difference between the two was significant.

3. The fifty, the majority of whom took anticonvulsive medication throughout the study, and the fifty, the majority of whom did not take anticonvulsive medication, did not differ significantly from each other in scholastic achievement gain regardless of school placement and teaching.

4. The fifty, the majority of whom did not take anticonvulsive medication, made small but statistically greater gain in IQ than the fifty classified as medicated.

It is warranted to conclude, therefore, that the type of educational placement and teaching which such children receive is the determining factor in the amount of scholastic progress they will make. There is no evidence from this study that anticonvulsive medication will contribute to scholastic achievement.

The implication is strong that schools would obtain maximal results with such children (a) if they refrained from referring them to special

education classes, but left them in the rich stimulating environment of the regular class; and (b) if they provided them with individualized clinical teaching outside of school hours as an extracurricular activity.

The implementation of such a program would depend upon the availability of specially trained clinical teachers and funds to finance the reduced pupil-load of the clinical teachers. These are matters upon which additional investigation is needed.

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APPENDIX A

Schematic design for statistical formulations

Pre Test Group A (Each S in regular class, receiving individual instruction and medication) N=25			Group B (Each S in regular class, receiving individual instruction and no medication) N=25			Group A & B (Each S in regular class, receiving individual instruction) N=50		
Subjects	GVR Test Score	WISC IQ's	Subjects	GVR Test Score	WISC IQ's	Subjects	GVR Test Score	WISC IQ's
01 02 03 | 025			026 027 | 050			01 02 | 050		
Group C (Each S in Special Ed. Class and receiving medication) N=25			Group D (Each S in Special Ed. Class and receiving no medication) N=25			Group C & D (Each S in Special Ed. Class) N=50		
Subjects	GVR Test Score	WISC IQ's	Subjects	GVR Test Score	WISC IQ's	Subjects	GVR Test Score	WISC IQ's
101 102 | 125			126 127 | 150			101 102 | 150		

Post Test

Group A (Each S in regular class, N=25 receiving individual instruction and medication)

Subjects	GVR Test Score	WISC IQ's
01		
02		
03		
⋮		
025		

Group B (Each S in regular class, N=25 receiving individual instruction and no medication)

Subjects	GVR Test Score	WISC IQ's
026		
027		
⋮		
050		

Group A & B (Each S in regular class N=50 receiving individual instruction)

Subjects	GVR Test Score	WISC IQ's
01		
02		
⋮		
050		

Group C (Each S in Special Education N=25 Class and receiving medication)

Subjects	GVR Test Score	WISC IQ's
101		
102		
⋮		
125		

Group D (Each S in Special Education Class N=25 and receiving no medication)

Subjects	GVR Test Score	WISC IQ's
126		
127		
⋮		
150		

Group C & D (Each S in Special Education N=50 Class)

Subjects	GVR Test Score	WISC IQ's
101		
102		
⋮		
150		

Pre & Post Test Comparisons were made between:

Group A and Group B
Group A and Group C
Group B and Group D
Group C and Group D
Groups A & B and Groups C & D

APPENDIX B

Formulas for t and F

$$t = \frac{(M_a - M_b)\sqrt{\frac{N_a N_b}{N_a + N_b}}}{\sqrt{\frac{N_a(SD)_a^2 + N_b(SD)_b^2}{}}}$$

When $N_a = N_b$, use N for both.

Then t simplifies to $$\frac{(M_a - M_b)\sqrt{N - 1}}{\sqrt{(SD)_a^2 + (SD)_b^2}}$$

When N = 25, the formula becomes

$$t = \frac{4.899(M_a - M_b)}{\sqrt{(SD)_a^2 + (SD)_b^2}}$$

In like manner, when both N's are 50,

$$t = \frac{7(M_a - M_b)}{\sqrt{(SD)_a^2 + (SD)_b^2}}$$

$$F^* = \frac{\frac{N_a(SD)_a^2}{N_a - 1}}{\frac{N_b(SD)_b^2}{N_b - 1}}$$

If $N_a = N_b$, the formula becomes

$$F = \frac{(SD)_a^2}{(SD)_b^2}$$

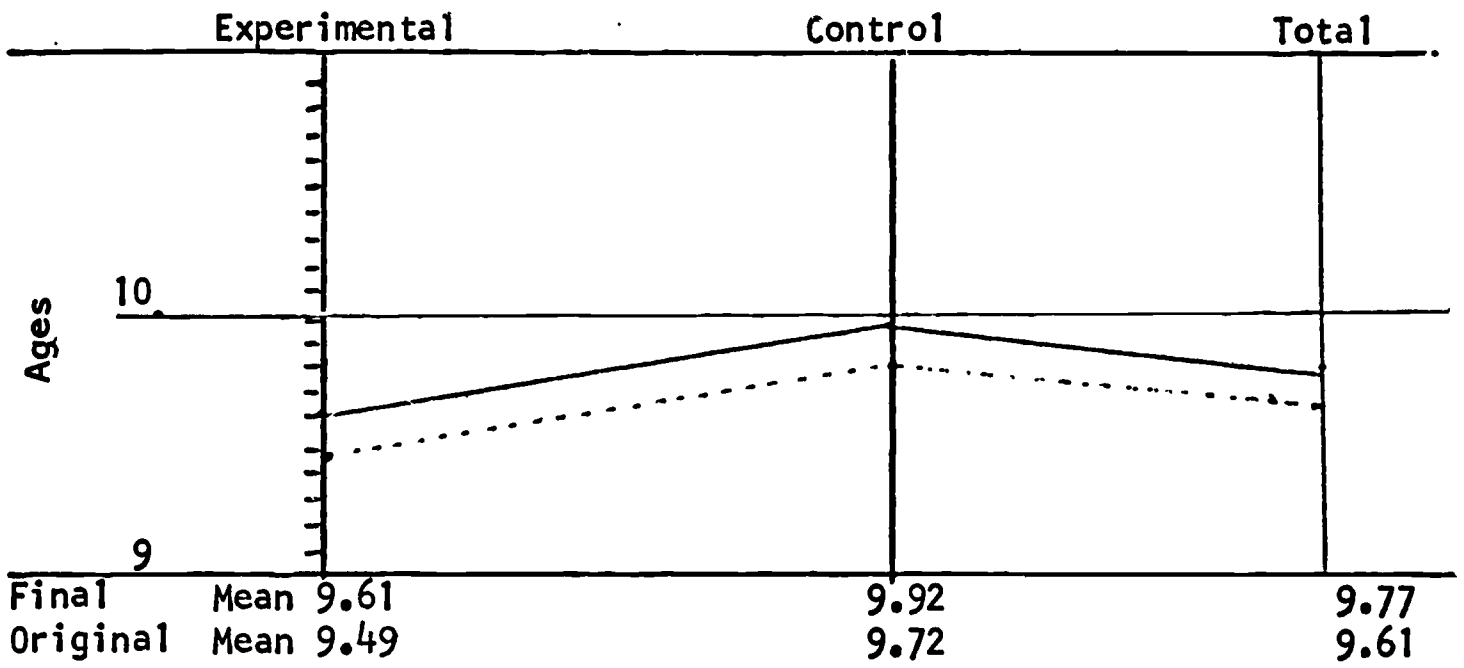
---

*Choose numerator and denominator so that the observed F is ≥ 1.

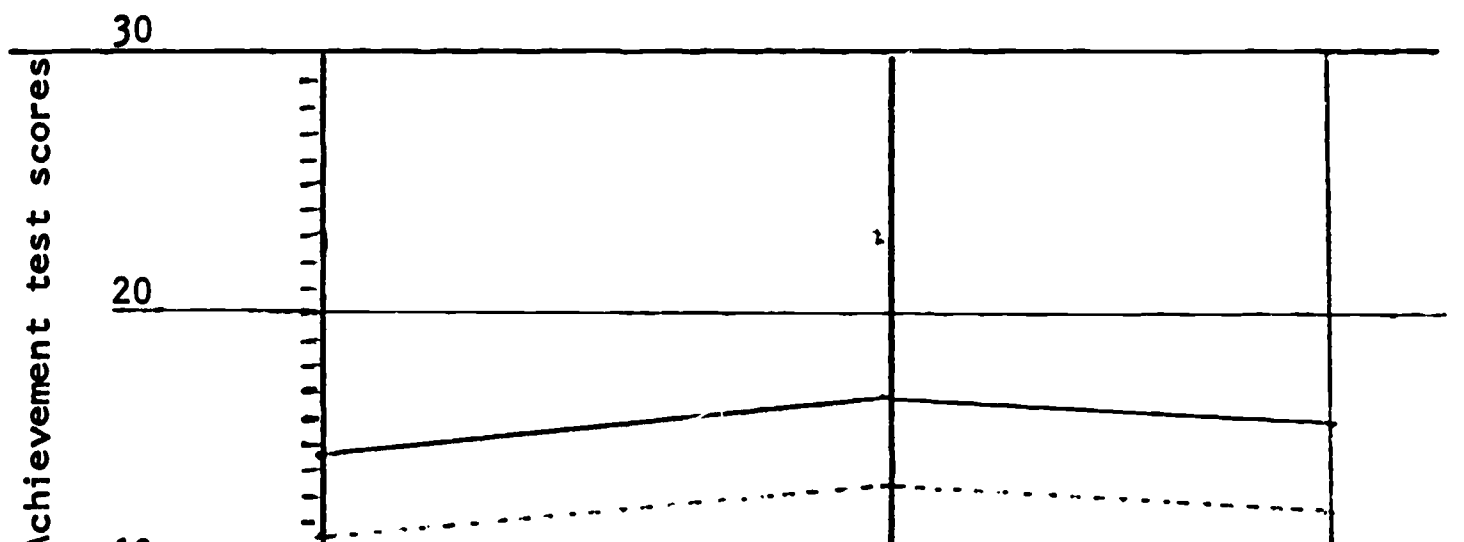
APPENDIX C

Original 100 subjects compared with final 100 after replacement of losses by preselected substitutes.

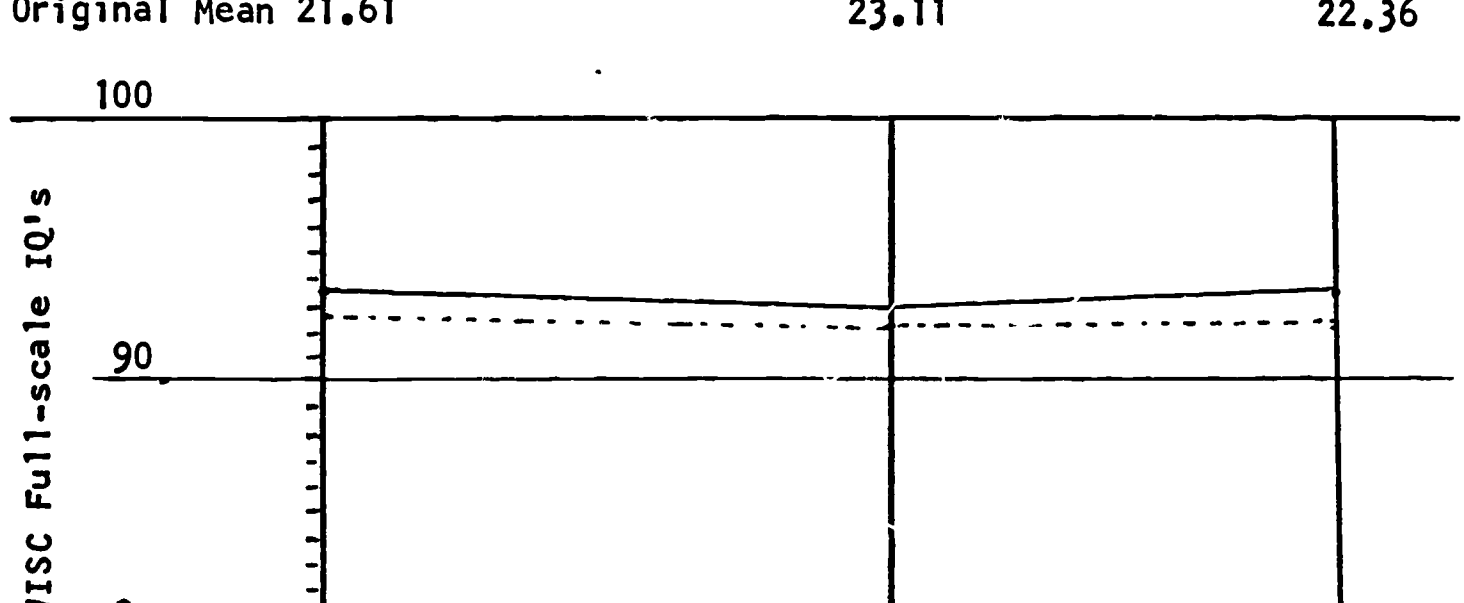
Key: ----- Original
——— Final



		Experimental	Control	Total
Final	Mean	9.61	9.92	9.77
Original	Mean	9.49	9.72	9.61



		Experimental	Control	Total
Final	Mean	24.57	26.50	25.53
Original	Mean	21.61	23.11	22.36



		Experimental	Control	Total
Final	Mean	93.72	92.84	93.28
Original	Mean	92.94	92.22	92.58

APPENDIX D

Comparison of differences in distribution of females in pairs of groups by Chi-square test

GROUP	f	F	f - F	$(f - F)^2$	$\frac{(f - F)^2}{F}$	Chi-sq.
A & B	12	11.5	.5	.25	.023	
C & D	$\frac{11}{23}$	$\frac{11.5}{23}$	-.5	.25	.023	0.046*
A & C	7	11.5	-4.5	20.25	1.761	
B & D	$\frac{16}{23}$	$\frac{11.5}{23}$	4.5	20.25	1.761	3.522*
A	4	3.5	.5	.25	.714	
C	$\frac{3}{7}$	$\frac{3.5}{7}$	-.5	.25	.714	1.418*
B	8	8	0	0	0	
D	$\frac{8}{16}$	$\frac{8}{16}$	0	0	0	0.00*
A	4	6	-2	4	.667	
B	$\frac{8}{12}$	$\frac{6}{12}$	2	4	.667	1.334*
C	3	5.5	-2.5	6.25	1.136	
D	$\frac{8}{11}$	$\frac{5.5}{11}$	2.5	6.25	1.135	2.272*

*P = $<$.05 with 1df

APPENDIX E

Comparison of ages to nearest half-years at beginning of study.

Class Inter.	Groups A	Groups C	Groups B	Groups D	Experimental A & B	Control C & D
13	2	1		1	2	2
12½	1	2	1	2	2	4
12		2	4	1	4	3
11½	4	2		1	4	3
11	2	5	1	1	3	6
10½	1	2	2	1	3	3
10	3	1	1	2	4	3
9½	2	1		1	2	2
9	2		2	2	4	2
8½		3	4	5	4	8
8	3	3	5	4	8	7
7½	2	3	2	1	4	4
7	3		3	3	6	3
N	25	25	25	25	50	50
M	9.76	10.10	9.22	9.34	9.49	9.72
SD	1.88	1.76	1.78	1.80	1.85	1.82
SE_M	.376	.351	.356	.360	.262	.257
SE_{SD}	.27	.27	.25	.26	.185	.182
Dif_M	.34		.12		.23	
$SE_{Dif\ M}$	.515		.506		.367	
Ratio	.66		.24		.63	
Chance Prob. of greater Dif M	51*/100		81*/100		53*/100	
Dif_{SD}	.12		.02		.03	
$SE_{Dif\ SD}$	.382		.361		.259	
Ratio	.31		.06		.13	
Chance Prob. of greater Dif SD	76*/100		95*/100		90*/100	

*The chance probabilities of greater differences in means and standard deviations arising from random samples of these sizes are so great that the samples above are acceptable as properly equated in central tendencies and variabilities.

APPENDIX F

Comparison of scholastic achievement test (GVR) scores at beginning of study.

	Groups		Groups		Experimental	Control
Class Inter.	A	C	B	D	A & B	C & D
57.0-59.9		1				1
54.0-56.9						
51.0-53.9				1		1
48.0-50.9			1		1	
45.0-47.9	1	1	1		2	1
42.0-44.9	1	1	2	2	3	3
39.0-41.9	2	2	1	2	3	4
36.0-38.9		1	1	1	1	2
33.0-35.9	2	1	1	1	3	2
30.0-32.9	3	2	1	1	4	3
27.0-29.9	2	3	1	2	3	5
24.0-26.9	5	2	1	2	6	4
21.0-23.9		1		1		2
18.0-20.9	1	1	1		2	1
15.0-17.9		2	3	2	3	4
12.0-14.9			1		1	
9.0-11.9		2	1	1	1	3
6.0- 8.9	2	1	3	4	5	5
3.0- 5.9	3		2	4	5	4
0- 2.9	3	4	4	1	7	5
N	25	25	25	25	50	50
M	22.81	24.37	20.41	21.85	21.61	23.11
SD	14.22	15.34	15.91	15.23	15.15	15.35
SE_M	2.84	3.07	3.19	3.05	2.14	2.17
SE_{SD}	2.01	2.17	2.25	2.15	1.52	1.54
Dif_M	1.56		1.44		1.50	
$SE_{Dif\ M}$	4.18		4.41		3.05	
Ratio	.37		.33		.49	
Chance Prob. of greater Dif M	71*/100		74*/100		62*/100	
Dif_{SD}	1.12		.68		.20	
$SE_{Dif\ SD}$	2.96		3.11		2.16	
Ratio	.38		.22		.09	
Chance Prob. of greater Dif SD	70*/100		83*/100		93*/100	

*The chance probabilities of greater differences in means and standard deviations arising from random samples of these sizes are so great that the samples above are acceptable as properly equated in central tendencies and variabilities.

APPENDIX G

Comparison of WISC full-scale IQ's at beginning of study.

	Groups		Groups		Experimental	Control
Class. Inter.	A	C	B	D	A & B	C & D
136-139				1		
132-135						
128-131						
124-127						
120-123	1	1	1		2	1
116-119				1		1
112-115	1		2		3	
108-111	1		1		2	
104-107		2	1	3	1	5
100-103	1		4	3	5	3
96-99	5	2	3	1	8	3
92-95	1	6	1	6	2	12
88-91	7	3	3	3	10	6
84-87	3	3	4	2	7	5
80-83	1	5	2	3	3	8
76-79	3	3		1	3	4
72-75	1		3		4	
68-71						
64-67						
60-63						
N	25	25	25	1/25	50	1/50
M	91.90	90.14	93.98	94.30	92.94	92.22
SD	11.20	10.08	12.76	14.18	12.04	12.48
SE_M	2.24	2.02	2.55	2.84	1.70	1.77
SE_{SD}	1.58	1.43	1.80	2.01	1.20	1.25
Dif_M	1.76		.32		.72	
$SE_{Dif\ M}$	3.02		3.82		2.45	
Ratio	.58		.08		.29	
Chance Prob of greater Dif M	56*/100		94*/100		77*/100	
Dif_{SD}	1.12		1.42		.44	
$SE_{Dif\ SD}$	2.13		2.70		1.73	
Ratio	.53		.53		.25	
Chance Prob of greater Dif SD	60*/100		60*/100		80*/100	

*The chance probabilities of greater differences in means and standard deviations arising from random samples of these sizes are so great that the samples above are acceptable as properly equated in central tendencies and variabilities.

APPENDIX H

Comparison of ages of final groups to nearest half-years by analysis of variance

		Group A				Group C				Group B				Group D			
Age	Sc	f	d	fd	fd^2	f	d	fd	fd^2	f	d	fd	fd^2	f	d	fd	fd^2
13	13	2	7	14	98	1	7	7	49					1	7	7	49
12.5	12	1	6	6	36	2	6	12	72	1	6	6	36	2	6	12	72
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
7.5	2	2	-4	-8	32	3	-4	-12	48	2	-4	-8	32	1	-4	-4	16
7	1	3	-5	-15	75					2	-5	-15	75	3	-5	-15	75
		25		+13	359	25		+30	344	25		-14	324	25		-8	326
Means				6.52				7.20				5.44				5.68 (Scale)	

Totals: From AM of 6.00, $\Sigma fd = +21$, M = 6.21, and $\Sigma fd^2 = 1353$

Then pooled $\Sigma x^2 = 1353 - 100(+21/100)^2$ or **1348.59**

Replace each interval observation by its own group mean:

Group M	6.52	7.20	5.44	5.68
Pooled M	6.21	6.21	6.21	6.21
Dif.	+.31	+.99	-.77	-.53 = 0
Sq.Dif	.0961	.9801	.5929	.2809
Times 25	2.4025	24.5025	14.8225	7.0225= **48.75**

Variability within individual groups:

Σfd^2	359	344	324	326
Less C $25(fd/25)^2$	6.76	36.00	7.84	2.56
	352.24	308.00	316.16	323.44= **1299.84**

Source of variance	df	Sum Squares	Variance	Observed F	Tabular $F_{(.10)}$
Among groups	3	48.75	16.25	1.20*	2.14
Within groups	96	1299.84	13.54		
		Ch'k. 1348.59			

*Since the observed F is smaller than the tabular F at the .10 level of confidence, the null hypothesis is accepted. No significant difference is present between any two groups of the six possible combinations of pairs of groups.

APPENDIX I

Comparison of pretest achievement test scores (GVR) of final groups by analysis of variance

Score Interval	Sc.	Group A f	d	fd	fd^2	Group C f	d	fd	fd^2	Group B f	d	fd	fd^2	Group D f	d	fd	fd^2
57.0-59.9	20					1	12	12	144								
54.0-56.9	19						11										
51.0-53.9	18						10							1	10	10	100
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
3.0- 5.9	2	3	-6	-18	108		-6			2	-6	-12	72	4	-6	-24	144
0.0- 2.9	1	3	-7	-21	147	4	-7	-28	196	4	-7	-28	196	1	-7	- 7	49
		25		+ 3	563	25		+16	664	25		-17	715	25		- 5	647
Means				8.12				8.64				7.32				7.80(Scale)	

Totals: From AM of 8.00, $\Sigma fd = -3$, M = 7.97, and $\Sigma fd^2 = 2589$

Then pooled $\Sigma x^2 = 2589 - 100(-3/100)^2$ or 2588.91

Replace each interval observation by its own group mean:

Group M	8.12	8.64	7.32	7.80
Pooled M	7.97	7.97	7.97	7.97
Dif	+.15	+.67	-.65	-.17=0
Sq. Dif	.0225	.4489	.4225	.0289
Times 25	.5625	11.2225	10.5625	.7225= 23.07

Variability within individual groups:

Σfd^2	563	664	715	647
Less C-- $25(fd/25)^2$	.36	10.24	11.56	1.00
	562.64	653.76	703.44	646.00= 2565.84

Source of variance	df	Sum Squares	Variance	Observed F	Tabular F(.10)
Among groups	3	23.07	7.69	.29*	2.14
Within groups	96	2565.84	26.73		
		2588.91 Ch'k.			

*Since the observed F is smaller than the tabular F at the .10 level of confidence, the null hypothesis is accepted. No significant difference is present between any two groups of the six possible combinations of pairs of groups.

APPENDIX J

Comparison of WISC pretest full-scale IQ's of final groups by analysis of variance

(IQ) Score Interval	Sc.	Group A f	d	fd	fd^2	Group C f	d	fd	fd^2	Group B f	d	fd	fd^2	Group D f	d	fd	fd^2
136-139	20													1	11	11	121
132-135	19														10		
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
120-123	16	1	7	7	49	1	7	7	49	1	7	7	49		7		
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
64- 67															-7		
60- 63														1	-8	-8	64
		25		-10	200	25		-21	177	25		+3	255	25		+5	315
Means				8.60				8.16				9.12				9.20 (Scale)	

Totals: From AM of 9.00, $\Sigma fd = -23$, M = 8.77, and $\Sigma fd^2 = 947$

Then pooled $\Sigma x^2 = 947 - 100(-23/100)^2$ or 941.71

Replace each observation by its own group mean:

Group M	8.60	8.16	9.12	9.20
Pooled M	8.77	8.77	8.77	8.77
Dif	-.17	-.61	+.35	+.43 = 0
Sq. Dif	.0289	.3721	.1225	.1849
Times 25	.7225	9.3025	3.0625	4.6225 = 17.71

Variability within individual groups:

Σfd^2	200	177	255	315
Less C-- $25(fd/25)^2$	4.00	17.64	.36	1.00
	196.00	159.36	254.64	314.00= 924.00

Source of variance	df	Sum Squares	Variance	F Observed	F(.10) Tabular
Among groups	3	17.71	5.90	.61*	2.14
Within groups	96	924.00	9.63		
		941.71 Ch'k.			

*Since the observed F is smaller than the tabular F at the .10 level of confidence, the null hypothesis is accepted. No significant difference is present between any two groups of the six possible combinations of pairs of groups.

APPENDIX K

Comparison of groups on basis of mean GVR total-average achievement gain scores

Group	Description	N	M	SD^2	Dif M	df	ob t
A + B	All Exp.	50	17.85	50.98	+6.59	98	4.75*
C + D	All Con.	50	11.26	43.43			
A + C	All Med.	50	13.75	53.14	-1.61	98	1.05**
B + D	None Med.	50	15.36	61.78			
A	Exp. Med.	25	17.43	48.16	+7.36	48	4.06*
C	Con. Med.	25	10.07	30.91			
B	Exp. Not Med.	25	18.27	53.44	+5.83	48	2.77*
D	Con. Not Med.	25	12.44	53.14			
A	Exp. Med.	25	17.43	48.16	- .84	48	.41**
B	Exp. Not Med.	25	18.27	53.44			
C	Con. Med.	25	10.07	30.91	-2.37	48	1.27**
D	Con. Not Med.	25	12.44	53.14			

*p is significant at .01 level of confidence

**p is significant at .05 level of confidence

APPENDIX L

Comparison of groups on basis of variability of total average gain scores on the GVR General Achievement Test

Group	Description	N	SD	SD^2	Dif SD	df	ob. F
A + B	All Exp.	50	7.14	50.98	+ .55	49,49	1.17*
C + D	All Con.	50	6.59	43.43			
A + C	All Med.	50	7.29	53.14	- .57	49,49	1.16*
B + D	None Med.	50	7.86	61.78			
A	Exp. Med.	25	6.94	48.16	+1.38	24,24	1.56*
C	Con. Med.	25	5.56	30.91			
B	Exp. Not Med.	25	7.31	53.44	+ .02	24,24	1.01*
D	Con. Not Med.	25	7.29	53.14			
A	Exp. Med.	25	6.94	48.16	- .37	24,24	1.11*
B	Exp. Not Med.	25	7.31	53.44			
C	Con. Med	25	5.56	30.91	-1.73	24,24	1.72*
D	Con. Not Med.	25	7.29	53.14			

*p is not significant at the .05 level of confidence

APPENDIX M

Comparisons of groups on basis of mean GVR reading gain scores (a reading gain was found by taking half the sum of the gain scores on Vocabulary and Reading Comprehension, thus permitting comparison of results with total average gain scores.)

Group	Description	N	M	SD^2	Dif_M	df	ob t
A + B	All Exp.	50	16.40	67.57	+5.02	98	2.81*
C + D	All Con.	50	11.38	89.11			
A + C	All Med.	50	12.77	78.15	-2.24	98	1.21
B + D	None Med.	50	15.01	88.54			
A	Exp. Med.	25	16.00	71.74	-6.46	48	2.72*
C	Con. Med.	25	9.54	64.00			
B	Exp. Not Med.	25	16.80	63.36	+3.58	48	1.34
D	Con. Not Med.	25	13.22	107.54			
A	Exp. Med.	25	16.00	71.74	- .80	48	.34
B	Exp. Not Med.	25	16.80	63.36			
C	Con. Med.	25	9.54	64.00	-3.68	48	1.38
D	Con. Not Med.	25	13.22	107.54			

*p is significant at .01 level of confidence.

APPENDIX N

Comparison of groups on basis of variability of GVR reading gain scores.

Group	Description	N	SD	SD^2	Dif_{SD}	df	F_{ob}
A + B	All Exp.	50	8.22	67.57	1.22	49,49	1.32*
C + D	All Con.	50	9.44	89.11			
A + C	All Med.	50	8.44	78.15	.97	49,49	1.13*
B + D	None Med.	50	9.41	88.54			
A	Exp. Med.	25	8.47	71.74	.47	24,24	1.12*
C	Con. Med.	25	8.00	64.00			
B	Exp. Not Med.	25	7.69	63.36	2.68	24,24	1.70*
D	Con. Not Med.	25	10.37	107.54			
A	Exp. Med.	25	8.47	71.74	.51	24,24	1.13*
B	Exp. Not Med.	25	7.96	63.36			
C	Con. Med.	25	8.00	64.00	2.37	24,24	1.68*
D	Con. Not Med.	25	10.37	107.54			

*p is not significant at .05 level of confidence.

APPENDIX O

Comparison of groups on basis of mean GVR spelling gain scores

Group	Description	N	M	SD^2	Dif_M	df	t_{ob}
A + B	All Exp.	50	17.46	123.88	+5.52	98	2.60*
C + D	All Con.	50	11.94	97.02			
A + C	All Med.	50	12.86	123.65	-3.68	98	1.70**
B + D	None Med.	50	16.54	105.68			
A	Exp. Med.	25	15.96	131.33	+6.20	48	1.98**
C	Con. Med.	25	9.76	104.65			
B	Exp. Not Med.	25	18.96	111.94	+4.84	48	1.67
D	Con. Not Med.	25	14.12	87.98			
A	Exp. Med.	25	15.96	131.33	-3.00	48	.94
B	Exp. Not Med.	25	18.96	111.94			
C	Con. Med.	25	9.76	104.65	-4.36	48	1.54
D	Con. Not Med.	25	14.12	87.98			

* p significant at .01 level of confidence.
** p significant at .05 level of confidence.

APPENDIX P

Comparison of groups on basis of variability of GVR spelling gain scores

Group	Description	N	SD	SD^2	Dif_{SD}	df	F_{ob}
A + B	All Exp.	50	11.13	123.88	+1.28	49,49	1.28*
C + D	All Con.	50	9.85	97.02			
A + C	All Med.	50	11.12	123.65	+ .84	49,49	1.17*
B + D	None Med.	50	10.28	105.68			
A	Exp. Med.	25	11.46	131.33	+1.23	24,24	1.25*
C	Con. Med.	25	10.23	104.65			
B	Exp. Not Med.	25	10.58	111.94	+1.20	24,24	1.27*
D	Con. Not Med.	25	9.38	87.98			
A	Exp. Med.	25	11.46	131.33	+ .88	24,24	1.17*
B	Exp. Not Med.	25	10.58	111.94			
C	Con. Med.	25	10.23	104.65	+ .85	24,24	1.19*
D	Con. Not Med.	25	9.38	87.98			

*p is not significant at the .05 level of confidence.

APPENDIX Q

Comparison of groups on basis of mean GVR arithmetic gain scores (an arithmetic gain score was found by taking half the sum of the gain scores on Arithmetic Reasoning and Arithmetic Computation, thus permitting comparison of results with total-average gain scores.)

Group	Description	N	M	SD^2	Dif_M	df	t_{ob}
A + B	All Exp.	50	18.36	57.46			
					6.94	98	4.14*
C + D	All Con.	50	11.42	80.28			
A + C	All Med.	50	14.89	77.97			
					.00	98	.00
B + D	None Med.	50	14.89	83.91			
A	Exp. Med.	25	19.04	50.69			
					8.30	48	3.69*
C	Con. Med.	25	10.74	70.73			
B	Exp. Not Med.	25	17.68	63.20			
					5.58	48	2.22**
D	Con. Not Med.	25	12.10	88.92			
A	Exp. Med.	25	19.04	50.69			
					1.36	48	.62
B	Exp. Not Med.	25	17.68	63.20			
C	Con. Med.	25	10.74	70.73			
					-1.36	48	.53
D	Con. Not Med.	25	12.10	88.92			

* p is significant at the .01 level of confidence.
**p is significant at the .05 level of confidence.

APPENDIX R

Comparison of groups on basis of variability of GVR arithmetic gain scores

Group	Description	N	SD	SD^2	Dif_{SD}	df	ob. F
A + B	All Exp.	50	7.58	57.46	-1.38	49,49	1.40*
C + D	All Con.	50	8.96	80.28			
A + C	All Med.	50	8.83	77.97	- .33	49,49	1.08*
B + D	None Med.	50	9.16	83.91			
A	Exp. Med.	25	7.12	50.69	-1.29	24,24	1.40*
C	Con. Med.	25	8.41	70.73			
B	Exp. Not Med.	25	7.95	63.20	-1.48	24,24	1.41*
D	Con. Not Med.	25	9.43	88.92			
A	Exp. Med.	25	7.12	50.69	-1.83	24,24	1.25*
B	Exp. Not Med.	25	7.95	63.20			
C	Con. Med.	25	8.41	70.73	-1.02	24,24	1.26*
D	Con. Not Med.	25	9.43	88.92			

*p is not significant at the .05 level of confidence.

APPENDIX S

Comparison of groups on basis of mean WISC Full-Scale IQ gain-points

Group	Description	N	M	SD^2	Dif_M	df	ob. t
A + B	All Exp.	50	+2.22	47.47	+4.48	98	3.21*
C + D	All Con.	50	-2.26	48.02			
A + C	All Med.	50	-1.48	59.14	+2.92	98	2.03**
B + D	None Med.	50	+1.44	42.12			
A	Exp. Med.	25	+ .60	54.17	+4.16	48	1.95**
C	Con. Med.	25	-3.56	55.50			
B	Exp. Not Med.	25	+3.84	35.40	+4.80	48	2.76*
D	Con. Not Med.	25	- .96	37.21			
A	Exp. Med.	25	+ .60	54.17	+3.24	48	1.676
B	Exp. Not Med.	25	+3.84	35.40			
C	Con. Med.	25	-3.56	55.50	+2.60	48	1.32
D	Con. Not Med.	25	- .96	37.21			

* p is significant at the .01 level of confidence.
**p is significant at the .05 level of confidence.

APPENDIX T

Comparison of groups on basis of variability of WISC Full-Scale IQ gain scores

Group	Description	N	SD	SD^2	Dif SD	df	ob. F
A + B	All Exp.	50	6.89	47.47	.04	49,49	1.01*
C + D	All Con.	50	6.93	48.02			
A + C	All Med.	50	7.69	59.14	1.20	49,49	1.40*
B + D	None Med.	50	6.49	42.12			
A	Exp. Med.	25	7.36	54.17	.09	24,24	1.02*
C	Con. Med.	25	7.45	55 50			
B	Exp. Not Med.	25	5.95	35.40	.15	24,24	1.05*
D	Con. Not Med.	25	6.10	37.21			
A	Exp. Med.	25	7.36	54.17	1.41	24,24	1.53*
B	Exp. Not Med.	25	5.95	35.40			
C	Con. Med.	25	7.45	55.50	1.35	24,24	1.49*
D	Con. Not Med.	25	6.10	37.21			

*p is not significant at the .05 level of confidence

APPENDIX U

Comparison of groups on basis of mean WISC Verbal Scale IQ gain points

Group	Description	N	M.	SD^2	Dif_M	df	ob. t
A + B	All Exp.	50	+1.90	50.98	+5.60	98	3.75*
C + D	All Con.	50	-3.70	58.37			
A + C	All Med.	50	-2.92	63.68	-4.04	98	2.62*
B + D	None Med.	50	+1.12	53.14			
A	Exp. Med.	25	+ .52	45.16	+6.88	48	3.31*
C	Con. Med.	25	-6.36	58.52			
B	Exp. Not Med.	25	+3.28	53.14	+4.32	48	2.15**
D	Con. Not Med.	25	-1.04	43.96			
A	Exp. Med.	25	+ .52	45.16	-2.76	48	1.36
B	Exp. Not Med.	25	+3.28	53.14			
C	Con. Med.	25	-6.36	58.52	-5.32	48	2.58*
D	Con. Not Med.	25	-1.04	43.96			

* p is significant at the .01 level of confidence.
**p is significant at the .05 level of confidence.

APPENDIX V

Comparison of groups on basis of variability of WISC Verbal Scale IQ gain points

Group	Description	N	SD	SD^2	Dif_{SD}	df	F_{ob}
A + B	All Exp.	50	7.14	50.98	- .50	49,49	1.14*
C + D	All Con.	50	7.64	58.37			
A + C	All Med.	50	7.98	63.68	+ .69	49,49	1.20*
B + D	None Med.	50	7.29	53.14			
A	Exp. Med.	25	6.72	45.16	- .93	24,24	1.30*
C	Con. Med.	25	7.65	58.52			
B	Exp. Not Med.	25	7.29	53.14	+ .66	24,24	1.21*
D	Con. Not Med.	25	6.63	43.96			
A	Exp. Med.	25	6.72	45.16	- .57	24,24	1.18*
B	Exp. Not Med.	25	7.29	53.14			
C	Con. Med.	25	7.65	58.52	+1.02	24,24	1.33*
D	Con. Not Med.	25	6.63	43.96			

*p is not significant at the .05 level of confidence.

APPENDIX W

Comparison of groups on basis of mean WISC Performance Scale IQ gain points

Group Description		N	M	SD^2	Dif M	df	ob. t
A + B All Exp.		50	+1.82	98.01	+2.38	98	1.19
C + D All Con.		50	- .56	99.20			
A + C All Med.		50	+ .04	120.56	-1.18	98	.59
B + D None Med.		50	+1.22	77.44			
A	Exp. Med.	25	+ .20	118.16	+ .32	48	.10
C	Con. Med.	25	- .12	124.99			
B	Exp.Not Med.	25	+3.44	72.59	+4.44	48	1.80*
D	Con. Not Med.	25	-1.00	72.93			
A	Exp. Med.	25	+ .20	118.16	-3.24	48	1.15
B	Exp. Not Med.	25	+3.44	72.59			
C	Con. Med.	25	- .12	124.99	+ .88	48	.31
D	Con. Not Med.	25	-1.00	72.93			

*p is significant at the .05 level of confidence

APPENDIX X

Comparison of groups on basis of variability of WISC Performance Scale IQ gain points

Group	Description	N	SD	SD^2	Dif SD	df	ob. F
A + B	All Exp.	50	9.90	98.01			
					- .06	49,49	1.01*
C + D	All Con.	50	9.96	99.20			
A + C	All Med.	50	10.98	120.56			
					+2.18	49,49	1.56*
B + D	None Med.	50	8.80	77.44			
A	Exp. Med.	25	10.87	118.16			
					- .31	24,24	1.06*
C	Con. Med.	25	11.18	124.99			
B	Exp. Not Med.	25	8.52	72.59			
					- .02	24,24	1.005*
D	Con. Not Med.	25	8.54	72.93			
A	Exp. Med.	25	10.87	118.16			
					-2.35	24,24	1.63*
B	Exp. Not Med.	25	8.52	72.59			
C	Con. Med.	25	11.18	124.99			
					+2.64	24,24	1.72*
D	Con. Not Med.	25	8.54	72.93			

*p is not significant at the .05 level of confidence.

APPENDIX Y

Comparison of pre- and post-test differences between all experimental subjects (Groups A and B) with all control subjects (Groups C and D) on each of 13 variables relative to scholastic achievement (GVR Test) and mental functioning (WISC), using computor techniques to derive scores on Student t and Chi square tests.

	All Control Groups C & D		All Experimental Groups A & B						Chi		
Variable	Mean	SD	Mean	SD	t	SE	df	p≤	sq.	df	p≤
1.g-v-r reading vocab.	12.42	12.02	19.04	10.45	-2.94	2.25	98	.01	21.71	13	.10
2.g-v-r reading compr.	10.34	10.67	13.76	11.70	-1.53	2.24	98		8.14	12	.80
3.g-v-r reading total	22.56	19.28	32.80	16.68	-2.84	3.61	98	.01	35.81	14	.01
4.g-v-r spelling	11.78	10.24	17.46	11.24	-2.64	2.15	98	.01	18.87	13	.20
5.g-v-r arith. reason.	10.12	11.99	17.54	12.44	-3.04	2.44	98	.01	22.58	13	.05
6.g-v-r arith. comput.	12.72	9.80	19.18	8.55	-3.51	1.84	98	.01	26.83	11	.01
7.g-v-r arith. total	22.84	18.11	36.72	15.31	-4.14	3.35	98	.01	26.33	14	.05
8.g-v-r total average	11.26	6.66	17.85	7.21	-4.75	1.39	98	.01	27.57	12	.01
9.g-v-r education grade	1.02	.61	1.56	.72	-4.76	.13	98	.01	24.45	11	.02
10.g-v-r educa-tion age	mos. 12.14	7.62	mos. 19.90	8.60	-4.78	1.62	98	.01	26.46	12	.01
11.wechsler verbal IQ	-3.70	7.72	1.90	7.15	-3.76	1.49	98	.01	13.44	10	.20
12.wechsler perform. IQ	-0.76	10.05	1.82	10.00	-1.29	2.00	98		16.20	12	.20
13.wechsler full IQ	-2.26	7.06	2.22	6.96	-3.20	1.40	98	.01	27.94	12	.01

APPENDIX Z

Comparison of pre- and post-test differences between all medicated subjects (Groups A and C) with all unmedicated subjects (Groups B and D) on each of 13 variables relative to scholastic achievement (GVR test) and mental functioning (WISC), using computor techniques to derive scores on Student $\underline{t}$ and Chi square tests.

	All Medicated Groups A & C		None medicated Groups B & D						Chi		
Variable	Mean	SD	Mean	SD	t	SE	df	p<	sq.	df	p<
1.g-v-r reading vocab.	16.46	13.13	15.00	10.12	.62	2.34	98		16.19	13	.30
2.g-v-r reading compr.	9.08	10.50	15.02	11.33	-2.72	2.18	98	.01	15.37	12	.30
3.g-v-r reading total	25.54	17.87	29.82	19.36	-1.15	3.73	98		20.93	14	.20
4.g-v-r spelling	12.70	11.50	16.54	10.39	-1.75	2.19	98		15.10	13	.50
5.g-v-r arith. reason.	14.46	12.27	13.20	13.24	0.49	2.55	98		12.68	13	.50
6.g-v-r arith. comput.	15.32	9.90	16.58	9.57	-0.65	1.95	98		12.00	11	.50
7.g-v-r arith. total	29.78	17.84	29.78	18.50	0.00	3.63	98		13.62	14	.50
8.g-v-r total average	13.75	7.36	15.36	7.94	-1.05	1.53	98		10.45	12	.70
9.g-v-r educa-tion grade	1.29	.75	1.38	.73	-0.61	.15	98		4.39	11	.98
10.g-v-r educa-tion age	15.56	8.99	16.48	9.02	-0.51	1.80	98		2.60	12	>.99
11.wechsler verbal IQ	-2.92	8.06	1.12	7.31	-2.63	1.54	98	.01	15.97	10	.20
12.wechsler perform. IQ	.04	11.14	1.02	8.93	-0.49	2.02	98		10.73	12	.70
13.wechsler full IQ	-1.48	7.82	1.44	6.55	-2.02	1.44	98	.05	16.66	12	.20

APPENDIX AA

Computor comparison between males and females in experimental group (A + B) on gains in scholastic achievement (GVR) and in mental functioning (WISC)

Variable	EXPERIMENTAL MALES (N=38) Mean	SD	EXPERIMENTAL FEMALES (N=12) Mean	SD	Student t	SE	df	p<	Chi sq.	df	p<
1.g-v-r reading vocab.	20.03	10.92	15.92	8.45	1.19	3.44	48	*	.25	2	.90*
2.g-v-r reading compr.	13.05	12.47	16.00	8.91	-.76	3.89	48	*	1.02	2	.70*
3.g-v-r reading total	33.08	18.06	31.92	11.90	.21	5.58	48	*	2.15	2	.50*
4.g-v-r spelling	16.92	12.47	19.17	5.97	-.60	3.75	48	*	3.24	2	.20*
5.g-v-r arith. reason.	18.13	12.90	15.67	11.15	.59	4.15	48	*	1.04	2	.70*
6.g-v-r arith. comput.	19.50	9.33	18.17	5.61	.47	2.85	48	*	1.05	2	.70*
7.g-v-r arith. total	37.63	15.91	33.83	13.44	.75	5.09	48	*	.03	2	.99*
8.g-v-r total average	17.78	7.53	18.08	6.39	-.13	2.41	48	*	1.68	2	.50*
9.g-v-r educa-tion grade	1.64	.73	1.72	.71	-.33	.24	48	*	.89	2	.70*
10.g-v-r educa-tion age	19.58	8.80	20.92	8.20	-.47	2.87	48	*	2.20	2	.50*
11.wechsler verbal IQ	2.71	7.05	-.67	7.15	1.44	2.34	48	*	.44	2	.90*
12.wechsler perform. IQ	1.55	9.74	2.67	11.18	-.33	3.34	48	*	2.28	2	.50*
13.wechsler full IQ	2.50	6.42	1.33	8.71	.50	2.32	48	*	.87	2	.70*

*p is NOT significant at .05

APPENDIX BB

Computor comparison between males and females in control group (C+D) on gains in scholastic achievement (GVR) and in mental functioning (WISC)

Variable	CONTROL MALES (N=39) Mean	S.D.	CONTROL FEMALES (N=11) Mean	S.D.	Student t	SE	df	p<	Chi sq.	df	p<
1.g-v-r reading vocab.	12.44	11.71	12.36	13.67	.02	4.15	48	-	2.51	2	.30
2.g-v-r reading compr.	11.33	11.02	6.82	8.89	1.25	3.62	48	-	1.71	2	.50
3.g-v-r reading total	23.77	19.59	18.27	18.37	.83	6.60	48	-	.84	2	.70
4.g-v-r spelling	12.05	10.87	10.82	8.00	.35	3.53	48	-	1.73	2	.50
5.g-v-r arith. reason	10.21	12.88	9.82	8.60	.09	4.13	48	-	2.99	2	.30
6.g-v-r arith. comput.	12.51	9.75	13.45	10.41	-.28	3.38	48	-	4.17	2	.20
7.g-v-r arith. total	22.72	19.22	23.27	14.24	-.09	6.24	48	-	4.93	2	.10
8.g-v-r total average	11.70	7.21	9.67	4.03	.89	2.28	48	-	1.64	2	.50
9.g-v-r education grade	1.05	.65	.90	.46	.71	.21	48	-	.97	2	.70
10.g-v-r educa-tion age	12.36	8.16	11.36	5.48	.38	2.62	48	-	.13	2	.95
11.wechsler verbal IQ	-3.36	8.03	-4.91	6.69	.58	2.65	48	-	5.19	2	.10
12.wechsler perform. IQ	-.38	10.63	-2.09	7.93	.49	3.46	48	-	.13	2	.95
13.wechsler full IQ	-1.79	7.77	-3.91	3.30	.87	2.42	48	-	.51	2	.80

APPENDIX CC

Computor comparison between males and females in medicated group (A+C) on gains in scholastic achievement (GVR) and mental functioning (WISC)

Variable	MEDICATED MALES (N =43) Mean	SD	MEDICATED FEMALES (N =7) Mean	SD	Student t	SE	df	p≤	Chi sq.	df	p≤
1.g-v-r reading vocab.	15.95	13.32	19.57	10.72	-.67	5.38	48	-	.79	1	.50
2.g-v-r reading compr.	9.53	10.74	6.29	8.99	.76	4.30	48	-	.41	1	.70
3.g-v-r reading total	25.49	18.41	25.86	15.36	-.05	7.36	48	-	.79	1	.50
4.g-v-r spelling	12.58	11.92	13.43	9.25	-.18	4.73	48	-	.03	1	.90
5.g-v-r arith. reason.	15.26	12.13	9.57	12.90	1.14	4.99	48	-	.41	1	.70
6.g-v-r arith. comput.	14.21	9.97	22.14	6.47	-2.03	3.91	48	.05**	1.23	1	.30**
7.g-v-r arith. total	29.47	18.02	31.71	17.87	-.31	7.34	48	-	.79	1	.50
8.g-v-r total average	13.59	7.51	14.73	6.77	-.38	3.03	48	-	0.00	1	>.99
9.g-v-r educa- tion grade	1.29	.77	1.28	.63	.03	.31	48	-	.03	1	.90
10.g-v-r education age	15.53	9.31	15.71	7.36	-.05	3.70	48	-	.03	1	.90
11.wechsler verbal IQ	-2.53	7.78	-5.29	9.98	.83	3.30	48	-	.03	1	.90
12.wechsler perform. IQ	.30	11.10	-1.57	12.12	.41	4.58	48	-	.00	1	.50
13.wechsler full IQ	-1.16	7.64	-3.43	9.29	.71	3.20	48	-	.41	1	.70

**P is significant at .05 level of confidence.

APPENDIX DD

Computor comparison between males and females in unmedicated group (B+D) on gains in scholastic achievement (GVR) and mental functioning (WISC)

Variable	UNMEDICATED MALES (N=34) Mean	SD	UNMEDICATED FEMALES (N=16) Mean	SD	Student t	SE	df	p<	Chi sq.	df	p<
1.g-v-r reading vocab.	16.47	9.61	11.88	10.79	1.52	3.03	48	-	4.62	3	.30
2.g-v-r reading compr.	15.53	12.17	13.94	9.58	.46	3.46	48	-	3.44	3	.50
3.g-v-r reading total	32.00	20.06	25.19	17.48	1.16	5.85	48	-	4.92	3	.20
4.g-v-r spelling	16.82	11.54	15.94	7.69	.28	3.18	48	-	.24	3	.98
5.g-v-r arith. reason.	12.68	14.93	14.31	8.93	-.40	4.05	48	*	8.91	3	.05*
6.g-v-r arith. comput.	18.18	10.00	13.19	7.81	1.76	2.84	48	-	10.25	3	.02
7.g-v-r arith. total	30.85	20.60	27.50	13.30	.59	5.65	48	-	8.64	4	.10
8.g-v-r total average	15.11	8.34	13.77	7.02	.97	2.41	48	-	1.93	3	.70
9.g-v-r educa-tion grade	1.40	.71	1.35	.78	.24	.22	48	-	1.92	3	.70
10.g-v-r educa-tion age	16.41	9.13	16.63	9.07	-.08	2.76	48	-	2.08	3	.70
11.wechsler verbal IQ	2.38	7.79	-1.56	5.46	1.82	2.17	48	-	5.85	3	.20
12.wechsler perform IQ	.91	9.03	1.25	8.99	-.12	2.73	48	-	.19	3	.98
13.wechsler full IQ	2.21	6.76	-.19	5.96	1.21	1.98	48	-	7.13	3	.10

*Variances differed here

APPENDIX EE

Ancillary data obtained at close of study, and six months later.

Two professionally trained social workers who had had no previous contact with the study were employed at the close of the two-year period to conduct private interviews with the parents of the one hundred children who had participated in the study for the purpose of obtaining information as to the following:

1. whether or not the children in the medicated groups had taken the anticonvulsive medication consistently, and those in the unmedicated groups had not taken anticonvulsive medication;

2. the reason for the shift if original plans to take or not take medication had been changed;

3. the name of the anticonvulsive drug taken;

4. the parents' attitudes toward the two types of educational programs, i.e., regular class plus clinical teaching, and a special education class;

5. the children's attitudes toward the two types of educational programs;

6. parents' evaluation of the school's reaction to the supplementary clinical teaching provided the children while they remained in the regular classroom, and

7. when parents were first aware that their child had a learning problem.

Six months after termination of the study the same two social workers were employed to contact the schools of each of the one hundred subjects to determine (a) if any of the fifty who had been in special education classes for MBI pupils (Groups C + D) had been returned to regular classrooms, and (b) if any of the fifty who had remained in regular classrooms during the study and received supplementary clinical teaching (Groups A + B) had been placed in special education classes.

The ancillary information obtained was as follows:

1. Consistency of taking or not taking anticonvulsive medication as prescribed at start of study (N = 100)

Groups A + C (Med.) Took medication		Groups B + D (Unmed.) Took anticonvulsants	
regularly	33	not at all	41
erratically	7	erratically	8
not at all	10	regularly	1
	50		50

2. Reason for not adherring to physicians' original advice regarding anticonvulsive medication (N = 26)

Groups A + C
(Did not take medicine as prescribed) N = 17

Parents "didn't think it was that important"	15
Child did not want to take it	1
Parent thought it was "bad for the child"	1
	17

Groups B + D
(Took anticonvulsive medication not prescribed) N = 9

Took a sibling's medication "to see if it would work"	5
Got a physician not associated with study to prescribe on a trial basis	2
Had been taking anticonvulsants prior to study but "kept it secret"	2
	9

3. Names of anticonvulsive drugs taken by Groups A and C (N = 50)*

Drug	No. subjects taking it*
Celontin	2
Dilantin	30
Eliptin	8
Mebaral	5
Mysoline	2
Paradione	1
Peganone	4
Phenobarbital	6
Tridione	1
Zarontin	1
	60*

*These numbers do not agree because two subjects took two drugs concomitantly, and the eight for whom Eliptin was originally prescribed were shifted by their physicians to another drug when Eliptin was removed from the market during the study.

4. and 5. Attitudes toward the two types of educational programs

	Regular Class + Clinical teaching Groups A + B N = 50		Special Education Class Groups C + D N = 50	
	Parents	Children	Parents	Children
Enthusiastic and pleased with program	43	42	32	17
Thought the program was stigmatizing and bad	2	5	17	15
Had no opinion one way or the other	5	3	1	18
N =	50	50	50	50

6. Parents' evaluation of school's reaction to supplementary clinical teaching (Groups A + B) N = 50

Thought school approved and was cooperative	32
Thought school disapproved and was uncooperative	11
Thought one teacher disapproved but others approved	7
N =	50

7. Parents' first awareness that child had a special learning problem N = 100

Before kindergarten	18
In kindergarten	13
First grade	35
Second grade	18
Third grade	7
Fourth grade	2
Fifth grade	5
Sixth grade	1
Did not know	1
N =	100

8. School placement at close of study and six months after close of study

	Groups A+B (N = 50)		Groups C+D (N=50)	
	Close	6 mos. later	Close	6 mos. later
Enrolled in Special Education Class, MBI	0	5	50	41
Enrolled in regular classroom	50	44	0	8
Whereabouts unknown	0	1	0	1
N =	50	50	50	50