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# The tape recorder employed in the development of children's singing: An experimental study

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THE TAPE RECORDER EMPLOYED IN THE DEVELOPMENT OF  
CHILDREN'S SINGING: AN EXPERIMENTAL STUDY

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A Thesis  
Presented to  
the Faculty of the School of Fine and Applied Arts  
Boston University

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In Partial Fulfillment  
of the Requirements for the Degree  
Master of Music

MUS. M

by  
Margaret Frances Sears  
August 1963

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### THESIS APPROVAL

*This thesis, written under the supervision of the candidate's Advisory Committee, and approved by its members, has been presented to and accepted by the Graduate Board of the School of Fine and Applied Arts of Boston University in partial fulfillment of the requirements for the degree of MASTER OF MUSIC with a major in*

..... Music Education .....

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### ACKNOWLEDGMENTS

The author expresses grateful appreciation to Mr. Lawrence Walsh, principal, and the teachers of grades one and two at the Dean S. Luce Elementary School in Canton, Massachusetts; without their fine cooperation, the experiment described in this study would have been impossible.

Sincere gratitude is extended to Dr. L. Eileen McMillan, Associate Professor of Music Education at Boston University, for her helpful suggestions and guidance in preparing the manuscript. The author is indebted also to Dr. Roderick D. Gordon, Chairman of the Department of Music Education at Boston University, for his invaluable aid in establishing the experimental procedure and analyzing the statistical data. The author's sister, Maryann Sears, was most helpful in assisting during the recording of the taped lessons and in the typing of the thesis.

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## CHAPTER I

### THE PROBLEM AND DEFINITIONS OF TERMS USED

In an era in which great emphasis is being placed on scientific and technological developments, artistic and aesthetic experiences should not be overlooked. Music is one of the few subject areas in the school curriculum which develops an awareness of aesthetic beauty and a capacity for response to art forms. It can be a vital means of self-expression and recreation which gives greater richness and depth to life, and yet it need not be in opposition to scientific instrumentation.

The developments in electronics and other technological advancements have affected music education in many ways. Children bring varied experiences with mass media of communication into the classroom. All are familiar with radio, television, and the movies which are used primarily for entertainment purposes. Some of the same media are used as teaching aids within the classroom. Phonograph records bring great symphony orchestras and performing artists to the classroom or make the teaching of a new song easy and enjoyable. Movies are used to bring children experiences they might not have otherwise; opaque projectors and film-strip projectors make it possible for all to see an object simultaneously.

Many schools own tape recorders which are effectively used in various phases of the curriculum. Occasionally they are used in a music class so that children may have an opportunity to hear themselves sing or play. With careful self-criticism, such an experience can be a vital aid in the growth and development of children's singing and playing.

When purchased for school use as audio-visual aids, all of these machines are intended to aid the teacher; none is expected to be an independent medium for teaching. However, unless they are in the hands of a qualified teacher who has well-defined objectives, these teaching aids are of little value. Even the most excellent educational television programs which are designed to instruct the children in a particular subject must be guided and followed up by the teacher. She is expected to review the new material, make applications of learnings gained, and often she must prepare the children for the next program.

The teaching potential of these audio-visual aids such as the tape recorder has only begun to be explored. Classroom teachers who are unskilled in certain areas need to have help not only in presenting new material, but also in reviewing and reinforcing familiar material. For example, many classroom teachers are extremely insecure in handling singing phases of the music program. The potential of tape recorded lessons planned and made by a music specialist in

which the classroom teacher is musically uninvolved would appear to be worth exploring, both for their value to the teacher and the children as well.

## I. THE PROBLEM

Statement of the problem. It was the purpose of this study (1) to devise a suitable way to use tape recorded lessons prepared by a music specialist in classrooms where the teacher is musically unskilled; and (2) to measure quantitatively the relative effectiveness of tape recorded lessons as compared with those taught by the average classroom teacher who is reasonably secure in her handling of singing activities.

Importance of the study. Many elementary schools currently employ a plan of a self-contained classroom. The classroom teacher is charged with the responsibility of teaching all subjects although, approximately once a week, she may receive the aid of specialists in music, art and other areas which require highly developed skills.

Theoretically each class of a given grade level has the same type and quality of musical experiences; actually these experiences vary with the classroom teacher's reaction toward music, depending on her musical ability and background as well as the capabilities of the children. Because singing is the principal activity of an elementary school

music program, it is especially important that all children have an opportunity to learn to sing correctly. However, it is not unusual to find teachers who either cannot or will not sing. Students of these teachers should not be deprived of satisfying singing experiences.

In recent years many valuable aids have been designed for musically unskilled teachers. Excellent books and phonograph records are now available, and it is possible to teach many songs both tastefully and enjoyably without the teacher's active participation. Because of the nature of the recordings, the children do not have enough opportunity to analyze songs by phrases or to work on a particularly difficult place.

An attempt was made in this study to invite frequent class participation, to create developmental learning situations, and to call constant attention to musical learnings of many types rather than merely teaching song material.

Delimitations. This study is concerned with singing as a singular experience of the music program and involves only early singing experiences. It is only indirectly concerned with any other musical learnings and focuses attention on those activities in which singing is most predominant. It solely involves first and second grade

classes and uses as a measure of skill in singing the reproduction of pitch, which admittedly is only one of many elements involved.

## II. DEFINITIONS OF TERMS USED

Music specialist. In this study the term, "music specialist", refers to the teacher who has had special professional, collegiate training in the field of music education. She is charged with the musical leadership of an elementary curriculum and makes weekly visits into the classroom.

Classroom teacher. The term, "classroom teacher", refers to that member of the faculty who is responsible for teaching the general classroom curriculum. When capable of doing so, she continues the music program between the specialist's visits.

Self-contained classroom. The term, "self-contained classroom", refers to a situation where the classroom teacher is responsible for teaching all subjects. In most schools she receives periodic aid from specialists in such areas as art, music, and physical education.

"Whole-part-whole" method. The term, "whole-part-whole method", refers to a method of teaching songs. After the song is heard as a whole, it is broken into phrase units.

The teacher takes "singing turns" first on one-phrase units and gradually builds the phrase patterns together until the song is learned as a unified whole.

Pre-test. The term, "pre-test", refers to the test of pitch reproduction given to each child before the experimental training period.

Post-test. The term, "post-test", refers to the identical pitch reproduction test but is re-administered after the experimental training period.

### III. SOURCES OF DATA

The sources of data included professional books on music education, professional periodicals, publications of various learned organizations and unpublished Masters' theses. The classroom experiment involving the tape recorder was a primary source of data.

### IV. ORGANIZATION OF THE REMAINDER OF THE STUDY

The study consists of six chapters. The first chapter includes the statement of the problem, definitions of terms used, delimitations, and the sources of data. Chapter II consists of a review of studies relevant to the problem. An overview of the development of children's singing and the problem of individual differences are

considered in the third chapter. Chapter IV includes a description of the groups involved in the experiment, the development and administration of the test, the lessons of the experiment, and the training period. An analysis of the data and results of the experiment are discussed in Chapter V. The final chapter is devoted to a summary of the study, together with conclusions and recommendations.

## CHAPTER II

### REVIEW OF RELATED RESEARCH

A review of previous research reveals that few scientific studies exist concerning the growth and development of children's singing and effective teaching methods for aiding children to learn to sing. The available studies were primarily of a subjective nature, and frequently the investigator used a group of subjects which was too small to provide reliable statistical information.

The lack of experimental studies in music education has been recognized by authorities for many years, but there has not been a significant amount of attention given to this deficiency. . . . (23:87)

Many of the studies dealing with problems of individual differences in children's singing use pitch discrimination as a main criterion of good singing. Causes of uncertain singers and remedial teaching techniques have been explored, but little has been done to discover methods to aid the classroom teacher who is inadequate in handling singing phases of the music program.

#### I. STUDIES INVESTIGATING CHILDREN'S SINGING

In 1951, Morel made a study of 121 first grade children to discover whether a relation exists between pitch discrimination and vocal reproduction of sounds. (8)  
Three tests were devised and administered. The first test

determined whether the concept of higher-lower in relation to pitch direction was understood by first grade children; the second determined the individual ability to discriminate various degrees of pitch differences, and the third measured the child's ability to sing. He concluded that the concept higher-lower is widely understood by first grade children and a slight relationship exists between the ability to discriminate pitch and to sing in tune. (The coefficient of correlation was .364.) However, he also concluded that the ability to discriminate pitch does not necessarily indicate that a child will reproduce vocally the exact pitch which may be given to him. (8:55)

Smith worked with 475 children studying the effect of training in pitch discrimination and found no evidence of any improvement in sensitiveness to pitch as a result of practice. (20:5-7) He conceded, however, that pitch discrimination is dependent in part upon ability to learn. He did report a coefficient of correlation between pitch discrimination and singing ability which is technically high. For boys, the coefficient of correlation was  $.71 \pm .023$ , and for girls,  $.51 \pm .031$ . (20:5) This data is more reliable than the conclusions of Morel, because Smith worked with 475 children as compared to 121 children in Morel's study.

In an investigation into the possibility of improving pitch discrimination made by Wyatt, much attention was given

to the individual differences of her subjects. (24) She tried to develop "work methods" suited to each subject and the results showed that pitch discrimination was improved when attention was given to individual differences. A similiar study was done by Seashore. (19:532-546) He, also, used the theory of individual differences and found considerable improvement after training, but he felt definite conclusions could not be made until more work had been done with that particular study.

Kane did an experimental study employing sustained-tone devices and different-pitched-tone devices to improve the pitch of uncertain singers. (5) The purpose of the study was to determine which of the two types was more effective. There were two groups of 23 children each who were trained individually for ten weeks. Although there were no definite conclusions, the children using the sustained-tone devices showed a slightly greater improvement.

## II. STUDIES INVESTIGATING THE USES OF A TAPE RECORDER WITH CHILDREN'S SINGING

The real potential of the tape recorder in the classroom remains relatively unexplored. However, general applications of the recorder to music instruction have been studied. Gillman reported the following values of the tape recorder in a music class:

a) self-appraisal and criticism; b) motivation; c) illustration of problems; d) illustration of techniques; e) teaching of appreciation; f) publicity and promotion; g) permanent reference. (3)

Perkins evaluated the tape recorder in terms of fulfilling basic educational needs of all public school pupils so far as the music curriculum is concerned. He employed the tape recorder in music classes over a three year period. Monthly recordings using new musical skills and learnings were planned and made by the students with the teacher's guidance. Each session required the participation of every student, either singing, speaking, or playing an instrument. The desire to achieve good results motivated self-discipline, provided opportunity for initiative and creative thinking, and made increasing demands on the musical skills of the students. (16:10-15)

The nature of the recordings made correlation with other subject areas easy and educational. Discussions of the social background of the music or the composer's life made an interesting relation to social studies. The narration on the recordings required skill in self-expression and mastery of English.

The theory of recording and the scientific principles involved in sound reproduction offered music and science teachers opportunities to correlate their programs; even mathematical skills were employed to provide proper timing of the material to be recorded.

Perkins also used the recorder to measure the change in musical skill of instrumental students. Comparisons of recordings made at various stages of development helped the student to know and understand his musical strengths and weaknesses. (16:23)

The results of the study showed that the use of the tape recorder can make significant contributions toward attaining educational objectives. It was further "concluded that the instantaneous [tape] recorder is a valuable tool in public school music education, and is. . . worthy of further use and investigation." (16:44)

It is apparent from the reported studies that research in the field of developing teaching techniques to help children learn to sing properly is scanty. Relations of individual hearing and singing abilities have been explored, and some methods to overcome singing problems have been studied. No studies were available involving the tape recorder as an independent teaching medium in any phase of music, nor were other teaching devices which could supplement a classroom teacher's musical skills sufficiently explored.

## CHAPTER III

### DEVELOPING SINGING IN EARLY CHILDHOOD

For most children, singing is a natural activity which normally asserts itself early in life. Of course, not all human beings are equally endowed, however, many small children sing very naturally and even make up melodies spontaneously at a very early age. In fact for a significant majority of children, singing remains one of the easiest and most rewarding mediums of musical expression. The fact that so many of their own thoughts and feelings can be expressed in song makes singing an effective means of communication for children. When taught skillfully, they learn quickly and enjoy songs which express thoughts, feelings or interests that they share.

The aesthetic development of children can be greatly enriched through song. The reflection of the mood and the message of the song can be seen on children's faces; they derive aesthetic pleasure not only by thoroughly knowing and understanding the music they sing, but also by becoming responsive to its musical beauty. Becoming sensitive to the qualities of good singing brings aesthetic experiences which can be shared with classmates, parents, and friends. As children grow older, they will realize the many facets of musical experiences which are available to them.

## I. THE RELATION OF SINGING TO THE LANGUAGE ARTS

The relation of singing and talking is quite close for children. They learn to sing in the same manner that they learn to speak. There are periods of discovery, exploration, experimentation, and application. (1:140) In the preliminary stages of learning to talk, a baby discovers that he can make various sounds with his voice. He explores the possibilities of various sounds and finds that by putting together certain combinations and attaching a meaning, he is able to communicate with words. Constant experimentation and application of what he has learned leads the child to the use of phrases and finally sentences. Of course, frequent mistakes are made in pronunciation and the sentence structure is not always correct. These inaccuracies are overlooked, however, because the child is learning to master verbal communication. Eventually, with plenty of free experience and good guidance, the speech of the child can become quite correct.

A parallel can be drawn in the development of the singing coordination. Children who hear songs naturally want to imitate them. At first the words may be spoken in the talking range, the only coordination the child knows. Gradually by exploration and experimentation of the possibilities of ways of using the voice, the child learns the singing coordination. It is expected that mistakes will be made and the

singing frequently will be inaccurate. These are the parallel difficulties a child encounters in learning to talk and learning to sing. Children do not learn to sing a whole song all at once. They first learn very short songs or even phrases which are repeated in a song. Gradually the child masters larger patterns and finally the entire song is clear in his mind. As the child explores and experiments, he finds he is capable of singing longer melodies. With encouragement and reassurance, he learns to make his singing more accurate and dependable on increasingly long and challenging song literature.

## II. EFFECTIVE MEANS OF HANDLING SINGING SITUATIONS

When a teacher introduces a song to children, it is important that she sing artistically and sincerely since she is the model for the children's voices. Because they are great imitators and naturally respect their teachers, young children's singing reflects not only patterns of tone quality and pitch, but also the general attitude and approach to singing. If the teacher's singing is relaxed and natural, the children will imitate these qualities. On the other hand, if the teacher is fearful and insecure, the children's singing will tend to reflect the same characteristics. When children achieve good singing, the teacher should be quick to comment in order that future successes may be easier to attain. The

teacher should sing songs for children with a clear voice unhampered by vibrato or other adult characteristics. The singing should be as light as possible and well supported with breath. (21:120) These vocal qualities make children conscious of the song rather than the singer. The correct style and mood of the song enhance its beauty and make the learning and singing of it a real musical experience.

#### Appropriate Song Material for Children

The main criterion in choosing songs for children to sing is that they be musical. Each song must have poetic and musical characteristics that will make it worthy of the time spent in learning it. The melody should be of good quality, easy to remember, and interesting even without words; it should also be in a comfortable range for children's voices. The rhythm should capture the mood and style of the music and yet be easy enough for young children to understand. By choosing a song with a text which relates to children's interests and which fits with the message and mood of the music, it is easy to provide satisfying musical experiences for the children. However, no matter how fine the text, only songs which have a definite musical appeal will remain in a child's repertoire. (21:38)

Folk songs. A great deal of the material in the standard music text books of the elementary school is folk

songs. They have an appeal for everyone; in fact, adults sing them with as much enthusiasm as children. They have a genuine reflection of all human emotions from feelings of despair, loneliness, and longing to those of fun, excitement, and elation. The mood of the music is equally varied ranging from serious songs to songs of a more humorous nature which are bright and lively. These are the songs created by people with a need for expression of all the emotions they have experienced in life. Through learning this literature of folk song, children in turn express their moods and emotions.

Art songs. All songs appropriate for children to sing need not be folk songs. Songs which relate to their immediate interests and environment are excellent if they are good musically. Many well known composers have written songs either for or about children; often these songs are appropriate even for young children's voices. By singing such songs, children not only learn good musical literature, they also have fine opportunities to learn about the composers who created the music.

Songs for special occasions. Music and especially song enhance the charm and festivity of seasonal holidays, patriotic holidays and other special occasions such as birthdays or changes in seasons. Through song children can acquire

an understanding of the tradition and customs of the peoples of many countries who celebrate Christmas, Hanukkah, and other festive days. The style and mood of the music brings messages to them that are sometimes difficult to express in words. Patriotic songs show children the rich tradition and heritage our country has and allows them to express their patriotic feelings in a personal and satisfying manner. A child who has a birthday is the center of attention while other children sing a birthday song to him. In a memorable way, he learns how music can help him celebrate his special day. Later he will share his feelings with other children who will have the song sung to them.

Songs composed by children. Often classroom situations can stimulate children's imagination, and an original song can be created with the guidance of a creative and resourceful teacher. The rain falling outside the window, the recent class trip to the zoo or the fun the children had while dramatizing a story about make-believe people is enough to provide stimulation and subject matter for a song. Excellent learning experiences can result from creating original songs. Children learn how to express themselves musically and also how notation represents the melodies they have made. Frequently songs of this nature which are composed as a result of children's daily experience remain in their repertoire for sheer musical enjoyment.

### Approaches to Teaching Songs by Rote

Awakening the child's interest in a song will naturally make him want to sing it. Sometimes a short story will help to prepare children for the mood of a song, or a picture will stimulate the imagination. If children are learning a song by rote, they must memorize the poem; consequently it is important that they understand the meaning and pronunciation of the words. They also must memorize the tonal patterns that make up the melody of the song. A clear mental image of these patterns is necessary before children will be able to reproduce them correctly.

Therefore ways of teaching the song that will help children to have a tonal memory of the tune are important. Of course, the exact method that a song is taught is not as important as the results that are achieved. A teacher learns by experience that a method which is appropriate for one song may not be feasible at all for the next. It is the teacher's sensitivity toward the music and the children that determine the method which will bring about singing that is not only accurate, but also sincere and musical. Regardless of the method that is used, the children should never be expected to sing any part of the song until they have heard it at least once in its entirety. Hearing the entire song allows the children to get the general message and mood of the song. With proper motivation, learning songs is enjoyable for both the teacher and the children.

The "all-join-in" method. If a song is short and has many repeated patterns, the children will enjoy singing along with the teacher after having heard it once or twice. Sometimes this method can be used on a refrain or one particular phrase that is repeated. The teacher can sing the entire song and ask the class to join in on the phrases that are the same. This method is especially good with very young children who have had little experience with group singing.

The "whole-part-whole" method. When a song has complex melody patterns, it is often advantageous to use the "whole-part-whole" method in teaching it. After the song has been heard as a whole, it is patterned by phrases and the teacher and children take "singing turns". First, one phrase units are sung and the teacher gradually combines the phrase units so that the entire song can be sung. If children realize they need help in learning the song, they will appreciate the "singing turns" and their singing will be more accurate and secure. It is important that the length of the patterns be increased as soon as possible so that the song will be learned as a unified whole. (7:33-34)

### III. INDIVIDUAL DIFFERENCES IN CHILDREN'S SINGING

The different singing skills that children have when they enter first grade is immediately apparent. However,

the reasons for the differences are as varied as the children themselves. The home environment and parental attitudes toward music and singing have direct influence on the child's approach to singing. If singing is accepted in the home as being natural and enjoyable, then children will accept it as a part of daily living. Often the child who cannot sing or is afraid to try has received harmful remarks such as, "You just can't sing; no one in this family can." It is true that the school has only a limited influence over home environment. However, teachers can do much to help to meet the needs of all children regardless of their level of development.

Characteristics of the child voice. No one set of characteristics will fit all children's singing voices; they are as different as individual personalities. Nevertheless, some general statements can be made. Mursell characterized the child voice and good singing in the following manner:

Good singing is characterized by high, clear voice quality and by evidence of enjoyment and understanding on the part of the singers, as well as correctness of tune, phrasing, tempo, enunciation, and pronunciation.  
(14:74)

It is interesting to note that he mentions enjoyment and understanding before emphasizing technical skills such as proper phrasing or tempo. Many of these details of good singing will come naturally if children know and enjoy what they are doing.

The development of the range and quality of children's voices is almost inseparable. The voice range in early childhood may begin with just a few notes. As singing becomes more secure, a range of approximately one octave (d above "middle c" to fourth line d) is average for most first and second grade children. (7:40) Children should always sing with a light, clear voice because that is natural for them. Singing too loud or too low can be detrimental for the proper development of the child's voice range and quality.

Types of individual differences in children's singing.

Although many variations will be noticed, three general classifications of children's singing can be described. They are:

1. The children who have learned to sing quite well.
2. The children who are in the process of learning the singing coordination, but are not sufficiently experienced for this coordination to be automatic or accurate.
3. The children who as yet have not discovered the coordination required for singing. (7:50)

Children in the first group have had experience, and they can sing familiar songs with reasonable accuracy. They also learn new songs quite rapidly if they have a good singing model. The second group of children who are learning the singing coordination can sing some songs, especially those with a limited range. They are frequently inaccurate but a

definite singing quality is evident. The third group of children have not experienced the singing coordination at all. They may be able to recognize familiar songs and frequently can distinguish the difference between talking and singing in other children. They have not personally been able to achieve a singing quality.

Helping the uncertain singer. Although having musical skills is a definite advantage to the teacher, greater value comes from understanding the child's particular musical problems and giving constant encouragement to him. One of the most important things for the teacher to remember is that children learn much better if they see a need for it. As Nye and Nye comment, "Learning takes place best in real life situations in which the learner participates and sees a need for learning." (15:8) The teacher can help the child to realize that singing is a normal part of daily life at school, and songs have personal meanings. Many immediate successes should be given to the child in varied musical activities.

It is important when they are learning to sing, that children understand they are learning a skill just as they are learning to master other skills. The way the teacher accepts children's singing problems influences their personal reaction toward new learning experiences in singing. No one

should embarrass a child by laughing at him or ridiculing his efforts. Above all, the music should never be considered more important than the child. Each child needs to feel secure and a necessary part of the group.

Helping the child to be more conscious of the pitch is of value in developing singing skills. If he is aware that the tune goes up or down, the child will try to make his voice do the same thing. Often hand motions help to intensify pitch consciousness. Diagrams on the chalk board also may be of help. Another important aid for the uncertain singer is the method used in teaching rote songs. In order to sing in tune, the child's mental image of the pitch patterns must be clear. If he does not know in his mind exactly what he is trying to sing, the results in terms of pitch will be hazy and inaccurate. This is why the "whole-part-whole" method is so valuable.

Since singing experiences are so vital in the music program, it is easy to understand why all children should develop their fullest capacity to sing. Any teaching aids or methods which benefit the singing program are of great importance to children's musical growth. The experimental procedure of this study was undertaken with this realization. It was designed to increase the skills of children who are learning to sing, thereby enabling them to know and love the rich resources of song literature available to them.

## CHAPTER IV

### THE EXPERIMENTAL STUDY OF TWO TEACHING PROCEDURES

The method of investigation for determining the relative effectiveness of the two teaching methods employed in this study was the experimental-control group technique. In this experiment, the two methods of teaching which were under comparative study were (1) the development of singing skills when taught by a tape recorded lesson prepared by the music specialist, and (2) the development of singing skills through presentation of the same lesson by a classroom teacher with reasonable competence in handling such activities. Both methods taught only follow-up lessons; the music specialist presented all new material when she visited and taught in each class once a week.

The subjects were confined to first and second grade since the problem was concerned with early singing experiences. Two first and two second grade classes were chosen as the control group, and two first and second grade classes which were as similar as possible comprised the experimental group. All eight classes were housed in the same building and had basically the same type of activities in each room. All of the classroom teachers in the school created a quiet, relaxed atmosphere for learning, and all were cooperative

with the music specialist. However, individual musical differences were noticeable among the teachers. This was, of course, a major consideration when the control and experimental groups were established.

## I. GROUPS INVOLVED IN THE STUDY

First grade. Since all the first grades were heterogeneous in intellectual ability, the main concern in dividing the control and experimental groups was that the teachers of the control classes were capable of singing for and with the children. Skill in music reading was not essential since all new material was presented initially by the music specialist. The two classes whose teachers felt most confident about singing became the control group and the other two classes were the experimental group.

Second grade. The second grades were a little more difficult to divide because they were grouped homogeneously according to academic ability. Therefore, it was necessary to have one average and one accelerated class for each of the control and experimental groups. Also, it was necessary again that musically capable teachers were to teach the control classes. Fortunately this presented no problem.

Combined grades. Before the experimental training period, there were 54 first grade children and 55 second

grade children in the control group. The experimental group had 56 first grade children and 56 second grade children, making a total of 221 children.

During the time of the experiment, some of the subjects necessarily were eliminated. In some cases they had moved from the school system; others had excessive absences so that it was felt they had not participated enough to permit their inclusion. Therefore after the training period, there were 50 first grade and 54 second grade children in the control group; 48 first and 48 second grade students comprised the experimental group. This total number of 200 children was used in all statistical computations. The results of the pre-tests of 21 children who did not complete the experimental period were deleted from the data.

One first grade class in the building was not needed for the experiment. Because the class was treated as a participating group, it provided the researcher with opportunities to check progress and growth although the results were not utilized in the established evaluation.

## II. DEVELOPMENT OF THE TEST

When determining the effectiveness of two teaching methods, it is necessary to find an objective means of measuring students' growth. A test usually is devised which measures some particular knowledge or skill quantitatively.

The identical test is administered before and after the training period. Any change in score represents the change in knowledge or skill of the student. A comparison of the scores obtained by students being taught by the two different procedures may be considered as an indication of the relative effectiveness of the teaching methods. This test is referred to as the pre-test or post-test, depending on when it is given in relation to the training period.

In this study the development of ability to reproduce pitch vocally was used to determine the effectiveness of a tape recorded lesson prepared by a music specialist as compared to the same lesson taught by a classroom teacher with average competence in handling singing activities. Many factors involved in singing are highly subjective, consequently only the important factor of pitch accuracy was evaluated. This could be done quantitatively.

In constructing the test certain points had to be taken into consideration. Because pitch reproduction was being evaluated, it had to be an oral test. It was necessary that each pattern be short enough so that the child's innate capacity of tonal memory could be minimized. The test had to be easy enough for most children to understand and successfully accomplish a large portion of it and yet difficult enough so that no child would get a perfect score; this established the child's maximum singing skill. The length

of the entire test was taken into consideration; it was important that the test be long enough to show the singing ability of the child and short enough to maintain his attention throughout.

### Preliminary Tests and Trial Findings

First trial test. A preliminary test was designed using groups of atonal patterns sung with the neutral syllable "loo". It was felt that by using atonal patterns and a neutral syllable, a technique employed by other investigators, it would be possible to minimize the effect of differing capacities of tonal memory. The length of the examples varied from two to seven notes as shown below.

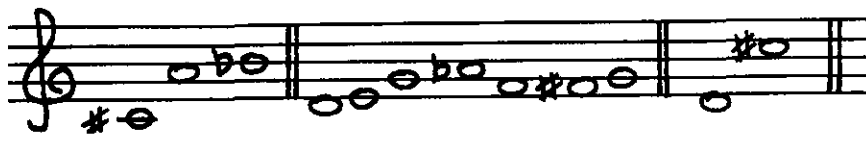


Illustration 1. Example of First Trial Test

This test was administered to a group of first and second grade children from a school not involved in the experiment. The patterns were sung by the investigator after which the child responded immediately. The oral response was tape recorded to permit scoring. This procedure is described in detail on page 33. Upon scoring these tests, it was found that the examples were too long

and too difficult. The primary problem seemed to lie in the use of atonal patterns. Children of this age group are not accustomed to hearing atonal music. The procedure for administering the test, however, was satisfactory for the purposes of this study.

Second trial test. Because practically all of the music that young children hear is based on common tonal patterns built on the major and minor scale, a second test was devised employing these intervals. Each example contained no more than four notes; the neutral syllable was employed again.



Illustration 2. Example of Second Trial Test

The same procedure for administration of the first test was followed with more effective results.

The use of a neutral syllable was debatable. It was felt by some that the use of sol-fa syllables would give the child a greater opportunity to discriminate tonal differences and therefore opportunity for more correct responses. The reaction against the use of sol-fa syllables was that the child would not only have to remember and respond to the correct pitch; but also he would have to remember the

syllable names, an experience not yet encountered by these children. It was decided to ascertain whether syllables affected pitch response.

Third trial test. A third test was then devised using the same type of tonal patterns. It was administered with both neutral syllables and sol-fa syllables. The same children took the test both ways, and a comparison of scores showed there was no noticeable difference between the use of the two kinds of syllables. The use of sol-fa syllables was retained for the final test.

#### The Final Test

The final test which was used in the experiment consisted of sixteen tonal patterns containing from one to five notes each. Most examples were either two or three notes long; there was a total of forty-seven individual notes. The patterns progressed in order of difficulty beginning with a single tone and working through the tonic triad, scale wise intervals, and minor and diminished intervals. The pitch range employed was from d above "middle c" to e flat (fourth space). (See page 32.)

Administration. In order to facilitate scoring of the tests and also to retain the vocal responses of each child, a tape recorder was placed nearby but out of sight to record the entire testing procedure. Each child was





The semi-tone deviation is indicated. It is important to note that the score then was an error score rather than a score of the total of correct responses. This entire procedure was followed before and after the training period, constituting the pre-test and post-test.

Before the experimental training period, the entire class was tape recorded while they sang familiar songs. Although these tapes were not used in this objective study, noticeable improvement was evident in the tapes of the class after the nine-week training period.

### III. THE TRAINING PERIOD

During the nine-week training period, the lessons maintained a great similarity. They emphasized good singing, reviewed and reinforced the lessons given by the music specialist and presented familiar songs in various ways to provide interest and motivation.

#### Characteristics of Lessons

Because the attention span of six and seven year old children is fairly short, and those children in the experimental classes would not have visual contact with the teacher during the music lesson, it was decided that each lesson should be not more than fifteen minutes in length. The variety of musical activities and materials was limited because of the

nature of the study. The taped lessons did not permit conversation between the teacher and the children, so all the lessons had to rely on total class response or silent response. These factors, plus the availability and convenience of using a series of six-hundred-foot tapes which played exactly fifteen minutes, determined the length of the lesson.

Tone Matching Games. During the early lessons, constant attention was focused on the difference between the talking and singing voice. Games were made up, as the examples show, in which both the singing and talking voices were used. Imitation of sirens and airplanes taking



off into the air stimulated the imagination and helped the children to use their voices in a variety of ways.

In the later lessons, the first portion was devoted to tone matching using the singing voice. The tone calls usually were incorporated into a game or story which stimulated the imagination and held the children's attention. They also were short and simple. Sometimes a tone call was created which could serve as an introduction to a familiar song. The call, "Oh John," as seen in the example, was interesting and effective as an introduction to the song, "Are You Sleeping?"



Oh John! Oh John!

Illustration 6. Example of Tone Call Used as Introduction

Presentation of song material. After the portion of the lesson emphasizing tone matching, a familiar song was sung. Often a pattern with obvious tonal direction was stressed by the teacher, either by using hand levels and/or by using sol-fa syllables. The syllables were used only by the second grade and were always sung first by the teacher.

Following the familiar song, the new song that had been taught by the specialist during her last visit was reintroduced using the "whole-part-whole" method. Ordinarily

the learning process was faster than in the first lesson on the song. Consequently the second verse, if the song had one, also was taught. This was usually a major portion of the lesson, after which favorite and familiar songs were sung. A phrase or pattern of each song was always emphasized and the children were reminded to sing musically and expressively.

In order to develop tonal memory, occasionally the teacher hummed a phrase of the song for the children to recognize. At first the initial phrase was used, but later any phrase was chosen. During the later lessons, the children were asked to choose songs that began low and went up high or ended by moving down. Before the songs were sung, the phrase with the particular melodic pattern that was called for was sung and hand levels were used to show visually the tonal direction.

Before the experiment was started, a trial lesson was tape recorded and used by a second grade not involved in the experiment. It was found to be entirely satisfactory.

#### Comparative Presentation of Lessons

At the beginning of the study, it was not known how long the training period would have to be to insure some change in the singing skills of the children. The extra first grade class proved to be very valuable in this matter. At the end of nine weeks, it was tested according to the

established procedure and found to have improved sufficiently to conclude the entire experiment.

Constants of both groups. The control and experimental groups were taught by the music specialist one half-hour per week. It was at this time that all new material was presented. The specialist's lessons included not only singing, which required a major portion of time, but also listening, rhythms, singing games and many other activities. The lessons were kept as closely identical as possible in the different classrooms. All children in the experimental and control groups received the same amount of training.

In addition to this half-hour, approximately 15 minutes was allotted each week to the singing of favorite songs of each class. No particular emphasis was placed on any musical learnings during this time. There was no restriction placed on any musical activity other than singing. Each teacher could do as much with listening, rhythms, or the playing of instruments as she felt desirable.

The experimental group. The experimental classes used a 15 minute tape recorded lesson that was prepared by the music specialist. The same lesson was heard twice during the week. The tapes had spaces for class response and were in every way as much like a normal classroom procedure as possible. In the actual recording of the tapes, the

class response was filled in by a light adult voice which provided the correct length of the spaces. The classroom teacher was not involved with any part of teaching. Her job was solely to set up the tape recorder, make sure the children were ready to sing and maintain order.

The control group. The control classes were taught by the classroom teacher. She was given the script of the tape recorded lesson and followed it as much as possible. These lessons were also 15 minutes long and were taught twice each week. Frequently the teacher of the control classes listened to the tape recorded lesson; this insured a greater similarity between her lessons and those prepared by the music specialist.

Seating of the children. After scoring the pre-tests of all the children, it was noticed that those children with a score above 70 errors were the poorest. In order that all children would have an equal opportunity to hear other children singing well, those children with high scores were placed throughout the classroom, no two sitting adjacent to each other. Those children whom it was found necessary to move were asked to take music seats each time they had a music lesson. Because such a situation necessitated moving the good singers as well as the poorer ones, no one was embarrassed.

The flexibility in scheduling the lessons made the entire experimental procedure a part of daily school life for the children. The fact that the classroom teachers had the responsibility of teaching music regardless of the experiment and the teachers of the control classes were using teaching aids, made the experimental situation quite a normal part of the self-contained classroom experiences. The teachers' attitude toward the experiment is discussed in Chapter V.

## CHAPTER V

### RESULTS OF THE EXPERIMENT

At the end of the experimental training period, certain tendencies could be noticed before any calculations were made. However, it was necessary to organize the data and determine central tendencies before any reliable results could be ascertained.

#### I. DEVELOPMENT OF PERCENTILE SCORES

After the nine-week training period, the pitch reproduction test was re-administered as the post-test, (Illustration 3, p. 32). The post-test error score was then subtracted from the pre-test score, as indicated in Table I, (see Appendix) to determine the change in singing skill.

The limit for maximum errors was set arbitrarily at 240. It was most difficult to count semi-tone errors above this point since these children were non-singers. Because in seven percent of the cases the errors could not be quantified, they were put in rank order. An ogive was constructed employing a smooth curve rather than a broken line. Ogives were constructed for each group in order to show general trends.

The median and quartile scores, as shown in Table II, (see Appendix) were taken from the ogives which, in this

particular instance, are more accurate than their determination from adjacent or discrete scores.

## II. ANALYSIS OF THE DATA

As will be noted in Table II, all experimental groups finished the training period with greater singing skills than the control groups. (See Appendix.) The median of the post-test for the first grade experimental groups was 28 errors; the first grade control groups was 36 errors. The second grade control groups had a median of 23 errors on the post-test while the second grade control median was 25 errors. The first grade control group showed a greater gain in skill than did the experimental group. The change in median ( $\Delta Md$ ) of the control group was 18 errors, the experimental group 14 errors. The difference between these scores is too small to be of any concern.

The second grade groups showed a decided difference in gain of singing skills since the change in median of the experimental group was 22 errors as compared to 10 errors in the control group. The difference is greater, perhaps, because the children are a little more mature than first grade children. They are quicker to grasp mental concepts and can deal with some of the abstract terms of music more adequately than can first grade children.

Both the first and second grade experimental groups showed a marked increase in homogeneity over the control groups. The change in quartile deviation ( $\Delta Q$ ) of the first grade control group was +1 but was -21 for the experimental group. The second grade control group showed a change in quartile deviation of -8 whereas that of the experimental group was -19.

In the individual classes,  $\Delta Md$  and  $\Delta Q$  were much less in the control groups than in the experimental groups. For example, the  $\Delta Md$  for the first grade control classes were 19 and 15 errors;  $\Delta Md$  for the experimental classes of the first grade were 4 and 48 errors. The details can be seen in Table II. (See Appendix.)

It is interesting to note that in most cases, the lower the pre-test score the greater the increase in skill of singing becomes. Class 1D was the poorest on the pre-test but it also had the maximum  $\Delta Md$  (48) with a  $\Delta Q$  of -47. This was also true with individual results: Subjects 88, 146, and 173 all pre-tested with scores above 240 errors, but their post-test scores were 40, 6, and 11 errors respectively. These are raw rather than percentile scores.

In both the control and experimental groups, the boys pre-tested with greater error than the girls. The first grade experimental boys had a median of 51 errors compared to 41 errors by the girls. However in all but the second

grade control group, the boys finished with greater singing skill than the girls. The first grade experimental boys had a median of 20 errors on the post-test while the girls had 30 errors. In every case  $\Delta M_d$  and  $\Delta Q$  for the boys was significantly greater than the girls as can be seen in Table I. (See Appendix.)

### III. REACTIONS OF THE EXPERIMENT

At the end of the training period, each classroom teacher was asked to write a short evaluation and personal reaction toward the part she and her class had in the experiment. Generally the reactions were positive and in both the experimental and control groups, the teachers themselves seemed to have profited. The following excerpts from the reactionary reports illustrate each teacher's opinion and evaluation of the experiment.

#### Classroom Teachers' Reactions

##### Teacher of Grade 1A, Control Class

In my opinion the experiment worked very well for my group. The detailed lesson plan helped me to vary the lesson hence avoid boredom. The children seemed to enjoy their lessons more. However, I felt limited at times with only 15 minutes for miscellaneous singing. The children seemed to learn more than just singing, (rhythm, introduction, etc.) which they would not have learned had we done the lessons on our own. After your introduction the lessons which I taught followed up each thing hence reinforcing the idea. Had I done the lessons on my own I probably would have concentrated on the songs alone.

### Teacher of Grade 1B, Control Class

The type of lessons which had been rehearsed and carefully planned and worked out were very beneficial to the children and to the teacher. Having an outline to work with gave the teacher a better idea of what learnings and appreciations the children needed. Also there were many musical ideas which a teacher who was not too well versed in music herself, could use with this class and future classes.

The children, themselves, profited by having a planned, timed lesson rather than an incidental music lesson . . . Children, guided by these lessons, learned many meanings of musical terms which would be of value in music theory . . . .

. . . Groups of children sang while others listened, thereby, giving more notice to those children who seldom participate in a music lesson for some unknown reason.

### Teacher of Grade 2B, Control Class

This experiment proved to be very enlightening as it gave the classroom teacher an organized lesson plan. Each plan presented a definite purpose for the song of the week . . . .

### Teacher of Grade 2A, Control Class

. . . The lesson plans were helpful in presenting ideas; but were somewhat inflexible. If the children expressed interest in some other phase of music, I had the feeling that we must cover the material in the lessons and that time didn't permit deviation. Of course, all this would probably be solved if it had not been an experimental situation . . . .

### Teacher of Grade 2C, Experimental Class

. . . As a teacher who is unable to teach music very effectively, the tapes were most helpful. The tapes were just long enough so that they could be played between teachings of other subjects.

By using the tapes the lessons were consistent and the children learned not only new songs but music reading which I am unfamiliar with. The children never tired of listening to the tapes and looked forward to them.

Teacher of Grade 2D, Experimental Class

I think the taped music lessons were excellent because they carried through the lesson taught by the music teacher every week. The children are apt to tire of the classroom teacher's voice, and the taped voice was better able to hold their attention. I believe that the classroom teacher should still devote some time to the music, so the children get a variety in the type of lesson.

Teacher of Grade 1C, Experimental Class

The children responded very well to the tapes. You retained their attention during each one of the lessons. They were useful in helping me learn unfamiliar songs. I felt a little restricted about teaching songs, I know, as the 15 minutes of singing really didn't allow enough time . . . .

Teacher of Grade 1D, Experimental Class

I enjoyed participating in the music program. Using the tapes gave the children and myself different music games to practice pitch. The children were very attentive and seemed to enjoy the tapes . . . .

Specialist's General Reaction

It was noticed by the music specialist that in addition to helping children to learn to sing, the entire experimental situation had other influences. Both the tapes and the scripts of the tapes served as an educational experience for the teacher. It was an opportunity to show classroom

teachers what can be done during the week with the material the specialist introduces during her lesson. The teachers not only learned what to do with a song but also how to do it.

As one of the teachers mentioned in her report, the length of the experimental lessons were good. The teachers of the experimental classes were fascinated with the excellent rapport of the class with the "tape recorder teacher". The children responded to questions and raised their hands just as if the teacher were actually in the room.

The music specialist noticed that the children were keenly aware of up and down patterns in a new song. Frequently a child made such a comment as, "That song starts low and goes up high."

During the music specialist's visits, she stopped songs that were not being sung as well as they could be. Discussion followed as to what would improve the singing. By the fifth week many children knew exactly what was wrong and could give good suggestions to make the singing more musical.

The continuity of lessons was excellent because the specialist controlled all the songs and musical learnings that were introduced. Perhaps for this reason or for some other unknown reason, a greater concentration of effort was noticeable in all the children. Each child knew what he was

trying to accomplish and understood why it was necessary to learn. This could also influence their concentration. Although this strict control, as was mentioned in some of the reaction reports, does not give the classroom teacher a chance to correlate music with other classroom experiences, nor can individual interests of the children be explored; the small percentage of time spent in this way allows the child to learn to sing more rapidly thereby enabling him to participate in widely varied musical activities with greater skill and satisfaction.

## CHAPTER VI

### SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

It was the purpose of this study (1) to devise a suitable way to use tape recorded lessons prepared by a music specialist in classrooms where the teacher is musically unskilled; and (2) to measure quantitatively the relative effectiveness of tape recorded lessons as compared with those taught by the average classroom teacher who is reasonably secure in her handling of singing activities.

#### I. SUMMARY

Since singing is the principal activity of an elementary school music curriculum, it is important that children have opportunities to learn to sing correctly. Individual differences of classroom teachers in the ability to sing and/or to teach singing make it worthwhile to provide teaching aids for those who are less able to handle singing phases of the music program.

Home environment, parental attitudes toward music and the child's personal experience with music and song create different stages of growth in singing among children entering the first grade. The school must be able to meet these individual differences in singing and provide experiences for the musical growth and development of all the children.

The procedure of the experiment of this study was the experimental-control group technique. Two first and two second grade classes were chosen as the experimental group and two similar classes of each grade level were the control group. The teachers of the control classes were able to handle singing phases of the music program adequately.

A test to measure the change in singing skills was designed which was administered to each child before and after the experimental training period. The test, which was administered orally by the music specialist with immediate vocal response from the child, consisted of common tonal patterns sung with sol-fa syllables. (See page 32.)

To facilitate scoring, the entire testing procedure was tape recorded. At a later time, the researcher transcribed the child's pitch response onto test manuscripts, multiple copies of which had been reproduced. Quantification of ability was achieved by counting the number of semi-tone deviations of the child's response from the correct pitch.

During the nine-week training period, the music specialist taught each class one half-hour per week. It was at this time that all new material was introduced. The experimental classes were taught during the week by the tape recorder. A fifteen minute lesson, prepared and made by the music specialist was heard twice during the week. It consisted of tone matching games, familiar songs, and a careful

re-teaching of the song introduced by the specialist during her previous visit. The teachers of the control classes were given the scripts of the tapes. They taught the same fifteen minute lesson twice a week and, by listening to the tapes themselves, were able to make it quite similar to that taught by the music specialist.

Both groups were allowed fifteen additional minutes per week to sing favorite songs. No limit was placed on any other musical activity.

At the end of the experimental training period, the pitch reproduction test was re-administered after which calculations to determine central tendencies were made. After the construction of ogives for the various groups, the median and quartile scores were determined.

The results showed that all experimental groups finished the training period with greater skill than the control groups. A greater gain in skill was achieved by the first grade control group, but the difference was practically negligible. The second grade experimental group showed a decided gain over the control group.

Both the first and second grade experimental groups showed a marked increase in homogeneity over the control groups. It was also noticed that those classes or individuals with the lowest achievement on the pre-test had the greatest increase in singing skills.

In every class the boys pre-tested with greater error than the girls. However, in all but one case, they finished with greater singing skill than the girls.

The reactions to the experiment by the classroom teachers generally were positive. It was felt that the lessons gave the children experiences they might not have had otherwise. The taped lessons held the children's attention and the script used by the teachers of the control classes proved to be an organized lesson plan. Although such a procedure requires rather strict control, the small percentage of time spent in this way seems to justify itself by the increased capacity to sing thereby enabling the children to participate in singing activities with greater skill and satisfaction.

## II. CONCLUSIONS

From the results of this study, it may be concluded that the tape recorder can be used effectively to aid in the development of children's singing. Suitable tape recorded lessons can be prepared and made by the music specialist which are not only as effective as those of the average classroom teacher, but actually achieve greater results. It is important that these lessons not be regarded as meeting the total music needs of children. These lessons are only one part of the music curriculum and children still need to

have opportunities for playing instruments, creating dances and the many other musical activities which are vital parts of a well balanced program.

### III. RECOMMENDATIONS

The following recommendations are made as a result of this study:

1. Further study should be made to find out whether the tape recorder can be used effectively in teaching singing in the upper elementary grades. Perhaps valuable results could be obtained by preparing lessons which aid in the development of part singing.

2. Finding the effectiveness of tape recorded lessons which teach music reading skills would appear to be worthy of study. Frequently the teacher who is insecure in singing finds it even more difficult to help children with music symbols.

3. The area of listening provides material for an interesting study. Often the classroom teacher wants her children to hear and enjoy compositions from the orchestral repertoire, but she does not know how to prepare the class to listen. Introductory material calling attention to changes in mood and rhythm or relating a story or interesting background information could be of great value.

4. An investigation into the possibility of using the tape recorder in the classroom for self-criticism would seem valuable. Some work has already been done in this area but many possibilities remain unexplored.

5. It is recommended that publishing companies be made aware of the possibilities of the tape recorder as an independent teaching medium. A series of taped lessons which actually teach songs from a particular music series could be made with special emphasis on developing good singing qualities. These tapes could be coordinated with the presently available records which give fine performances of the songs in the series rather than offering methods of teaching.

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## **APPENDIX**

TABLE I

## TEST SCORES FOR INDIVIDUAL SUBJECTS ACCORDING TO GROUP

Group*	Subject	Pre-test	Post-test	Gain**
1A	1	80	135	-55
	2	59	44	15
	3		90	
	4	97	97	0
	5	62	78	-16
	6	89	84	5
	7	28	3	25
	8	155	57	98
	9	4	2	2
	10	35	8	27
	11	58	38	20
	12	60	46	14
	13	23	21	2
	14	10	7	3
	15	31	35	-4
	16	53	27	26
	17	44	60	-16
	18	22	18	4
	19	98	211	-113
	20	128	39	89
	21	106	50	56
	22	26	15	9
	23	33	11	22
	24	54	34	20
	25	33	9	24
	26	65	44	21
1B	27	76	33	43
	28	28	30	-2

\*Groups A and B are control classes; groups C and D are experimental classes.

\*\*Gain is pre-test score minus post-test score. A loss of skill is indicated by a minus sign.

TABLE I (continued)

Group	Subject	Pre-test	Post-test	Gain
	29	47	40	7
	30	55	17	38
	31	48	68	-20
	32	23	23	0
	33	38	20	18
	34	8	11	-3
	35	240		
	36	53	39	14
	37	21	28	-7
	38	76	66	10
	39	22	9	13
	40	63	45	18
	41		139	
	42	109	108	1
	43	46	39	7
	44	21	16	5
	45	51	25	26
	46	60	17	43
	47	27	24	3
	48	72	68	4
	49	61	58	3
	50	73	36	37
1C	51	29	23	6
	52	61	64	-3
	53	25	12	13
	54	174	147	27
	55	71	44	27
	56	36	75	-39
	57	139	59	80
	58	14	18	-4
	59	14	21	-7
	60	25	8	17
	61	14	12	2
	62	38	52	-14
	63	21	10	11
	64	1	9	-8
	65	23	31	-8

TABLE I (continued)

Group	Subject	Pre-test	Post-test	Gain
	66	17	8	9
	67	44	19	25
	68	25	8	17
	69	143	139	4
	70	19	15	4
	71	105	80	25
	72	5	1	4
	73	16	4	12
	74	66	46	20
	75	16	0	16
1D	76		61	
	77	34	29	5
	78	94	17	77
	79	142	86	56
	80	56	56	0
	81	117	27	90
	82		110	
	83	147	21	126
	84	2	0	2
	85	44	22	22
	86	7	1	6
	87	39	29	10
	88		40	
	89	69	34	35
	90	104	71	33
	91		10	
	92	46	7	39
	93	44	21	23
	94	22	26	-4
	95	120	86	34
	96		68	
	97	12	15	-3
	98	42	51	-9
2A	99	17	7	10
	100	19	41	-22
	101	28	15	13
	102	24	32	-8
	103	51	38	13

TABLE I (continued)

Group	Subject	Pre-test	Post-test	Gain
	104	91	70	21
	105	50	53	-3
	106	9	2	7
	107	43	30	13
	108	36	34	2
	109	61	80	-19
	110	63	34	29
	111	95	97	-2
	112	38	54	16
	113	83	56	27
	114	122	99	23
	115	140	60	80
	116	32	19	13
	117	29	23	6
	118	160	157	3
	119	165	60	105
	120	43	55	-12
	121	42	34	8
	122	11	6	5
	123	87	57	30
	124	0	5	-5
	125	20	14	6
	126	53	42	11
	127	80	54	26
	128	40	29	11
	129	9	0	9
	130	8	0	8
2B	131	20	13	7
	132	24	3	21
	133	67	6	21
	134	42	17	25
	135	6	2	4
	136	85	48	37
	137	11	1	10
	138	28	28	0
	139	1	9	-8
	140	89	33	56

TABLE I (continued)

Group	Subject	Pre-test	Post-test	Gain
	141	14	15	-1
	142	13	2	11
	143	22	20	2
	144	19	13	6
	145	15	16	-1
	146		6	
	147	6	0	6
	148	37	14	23
	149		45	
	150	20	74	-54
	151	5	1	4
	152	33	14	19
20	153	46	54	-8
	154		60	
	155	48	34	14
	156	9	3	6
	157	19	0	19
	158	16	1	15
	159		24	
	160	15	23	-8
	161	18	7	11
	162	18	3	15
	163		32	
	164	1	0	1
	165	47	19	28
	166	89	63	26
	167	12	7	5
	168	226	74	152
	169	39	14	25
	170	75	43	32
	171	120	52	68
	172	13	1	12
	173		11	
	174	22	4	18
	175	76	42	34
	176	2	3	-1
	177	9	1	8

TABLE I (continued)

Group	Subject	Pre-test	Post-test	Gain
2D	178	64	50	14
	179	52	30	22
	180	42	43	-1
	181	209	93	116
	182	38	24	14
	183	112	14	98
	184	43	8	35
	185	24	12	12
	186	49	10	39
	187	65	41	24
	188	121	50	71
	189	57	24	33
	190	71	67	4
	191	124	5	119
	192	19	6	13
	193	70	47	23
	194	15	0	15
	195	18	15	3
	196	116	117	-1
	197	76	64	12
198	79	53	26	
199	2	0	2	
200	15	1	14	

TABLE II

## MEDIAN AND QUARTILE SCORES OF CONTROL AND EXPERIMENTAL GROUPS

Group	Control Group										Experimental Group									
	Pre-test				Post-test				$\Delta$ Md	$\Delta$ Q*	Pre-test				Post-test				$\Delta$ Md	$\Delta$ Q*
	Md	Q <sub>L</sub>	Q <sub>H</sub>	Q	Md	Q <sub>L</sub>	Q <sub>H</sub>	Q			Md	Q <sub>L</sub>	Q <sub>H</sub>	Q	Md	Q <sub>L</sub>	Q <sub>H</sub>	Q		
Grade 1 (A+B)	54	78	36	21	36	62	17	22	18	1										
Grade 1A	55	88	38	25	36	67	13	27	19	2										
Grade 1B	51	78	34	22	36	60	18	21	15	-1										
Grade 1 (C+D)											42	104	18	43	28	55	10	22	14	-21
Grade 1C											26	60	10	25	22	50	8	21	4	-4
Grade 1D											82	166	28	69	34	60	15	22	48	-47
Grade 2 (A+B)	35	70	14	28	25	48	7	20	10	-8										
Grade 2A	44	78	20	29	38	57	16	20	6	-9										
Grade 2B	28	54	12	21	10	22	4	9	18	-12										
Grade 2 (C+D)											45	96	17	39	23	47	7	20	22	-19
Grade 2C											34	106	12	47	15	42	4	19	19	-28
Grade 2D											58	98	26	36	30	56	10	23	28	-13
Girls 1 (A+B)	49	78	30	24	39	68	17	25	10	1										
Boys 1 (A+B)	55	80	34	23	34	62	15	23	21	0										
Girls 1 (C+D)											40	108	22	43	30	54	14	20	10	-23
Boys 1 (C+D)											51	114	16	49	20	48	6	21	31	-28
Girls 2 (A+B)	33	60	19	20	23	40	7	16	10	-4										
Boys 2 (A+B)	44	102	16	43	26	58	10	24	18	-19										
Girls 2 (C+D)											44	90	26	32	26	46	10	18	18	-14
Boys 2 (C+D)											46	96	18	39	20	46	8	19	26	-20

\*Negative sign indicates increased homogeneity of groups after training.

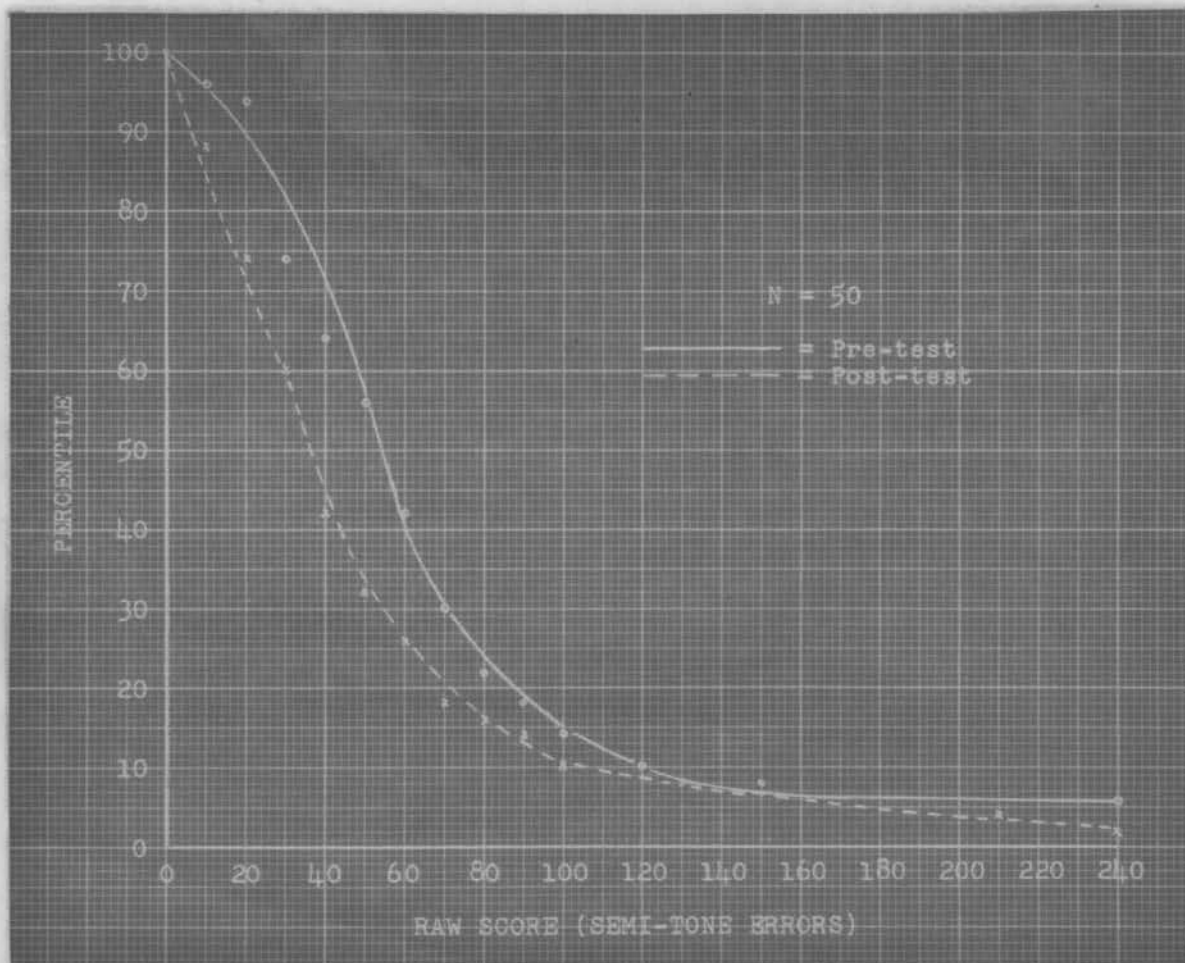


FIGURE 1

FIRST GRADE CONTROL GROUP TEST SCORES

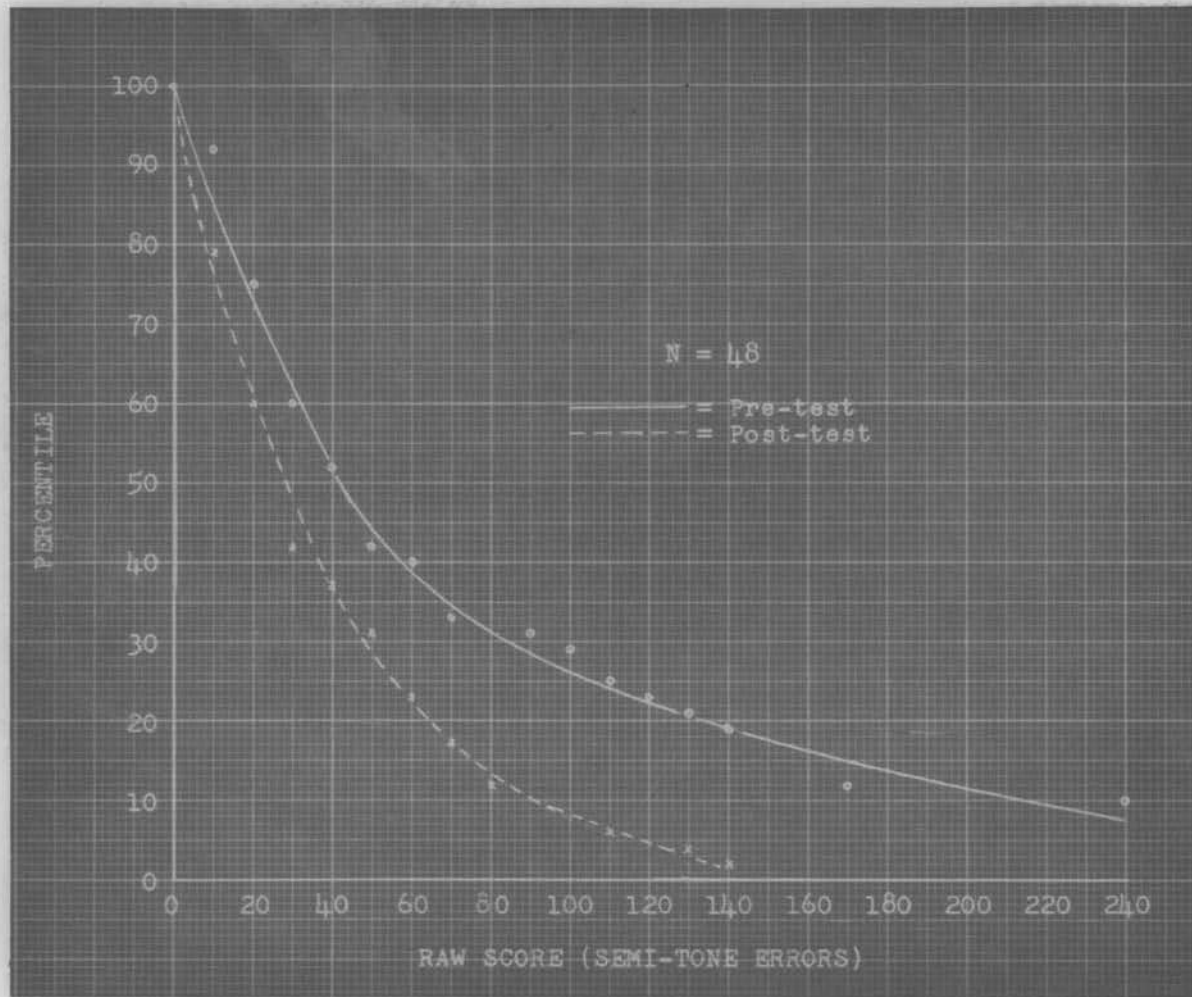


FIGURE 2

FIRST GRADE EXPERIMENTAL GROUP TEST SCORES

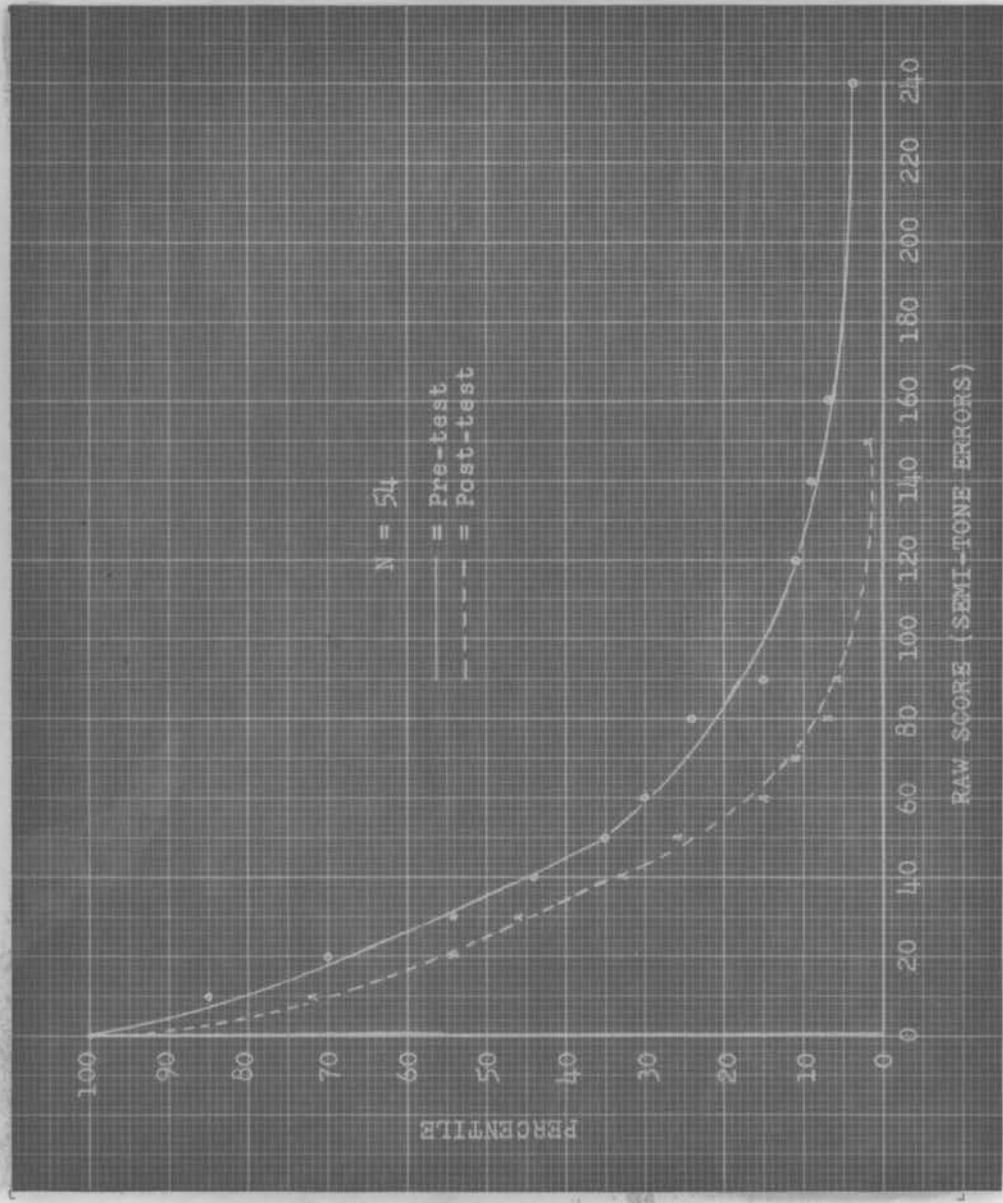


FIGURE 3  
SECOND GRADE CONTROL GROUP TEST SCORES

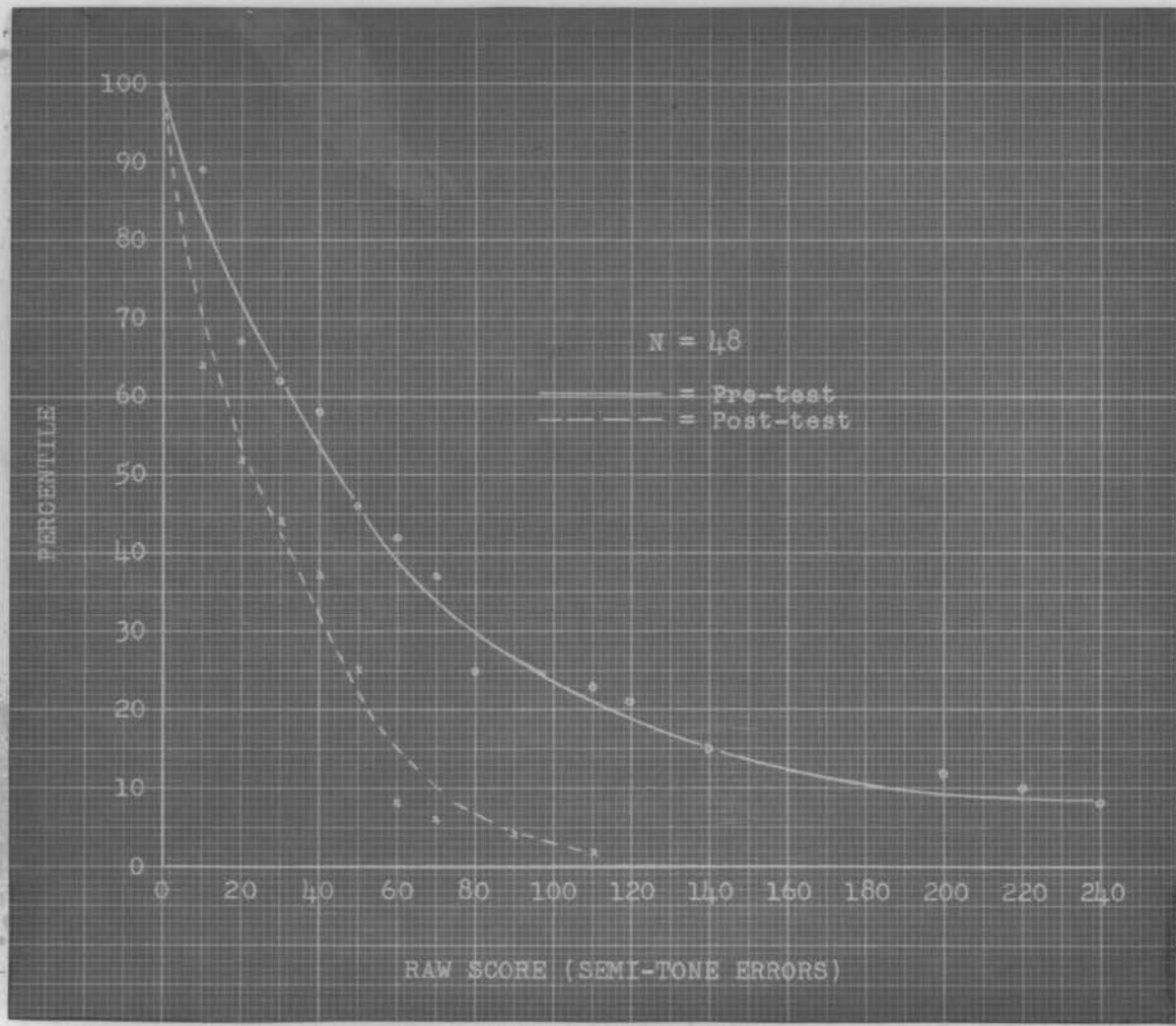


FIGURE 4

SECOND GRADE EXPERIMENTAL GROUP TEST SCORES

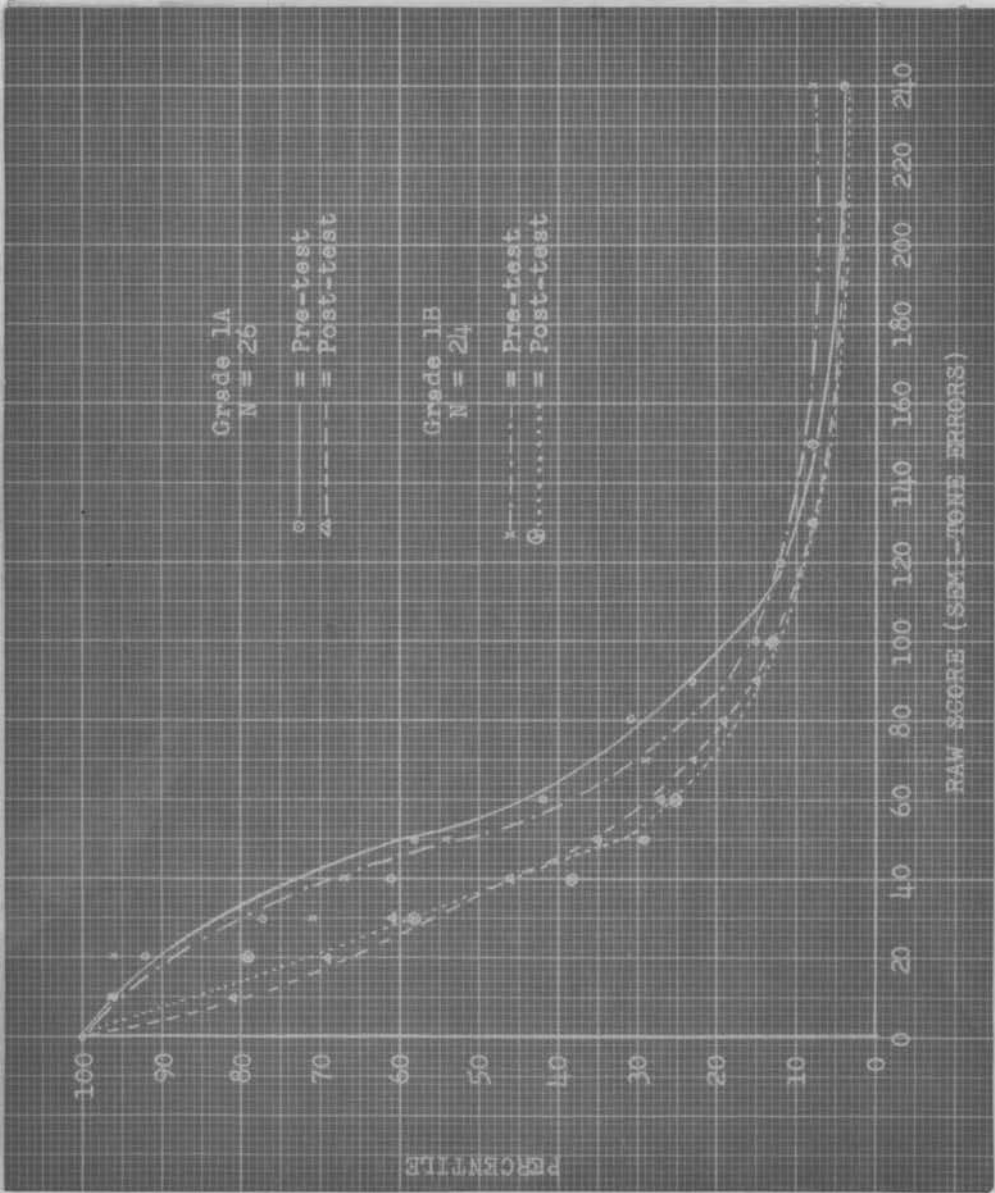


FIGURE 5  
FIRST GRADE CONTROL CLASSES TEST SCORES

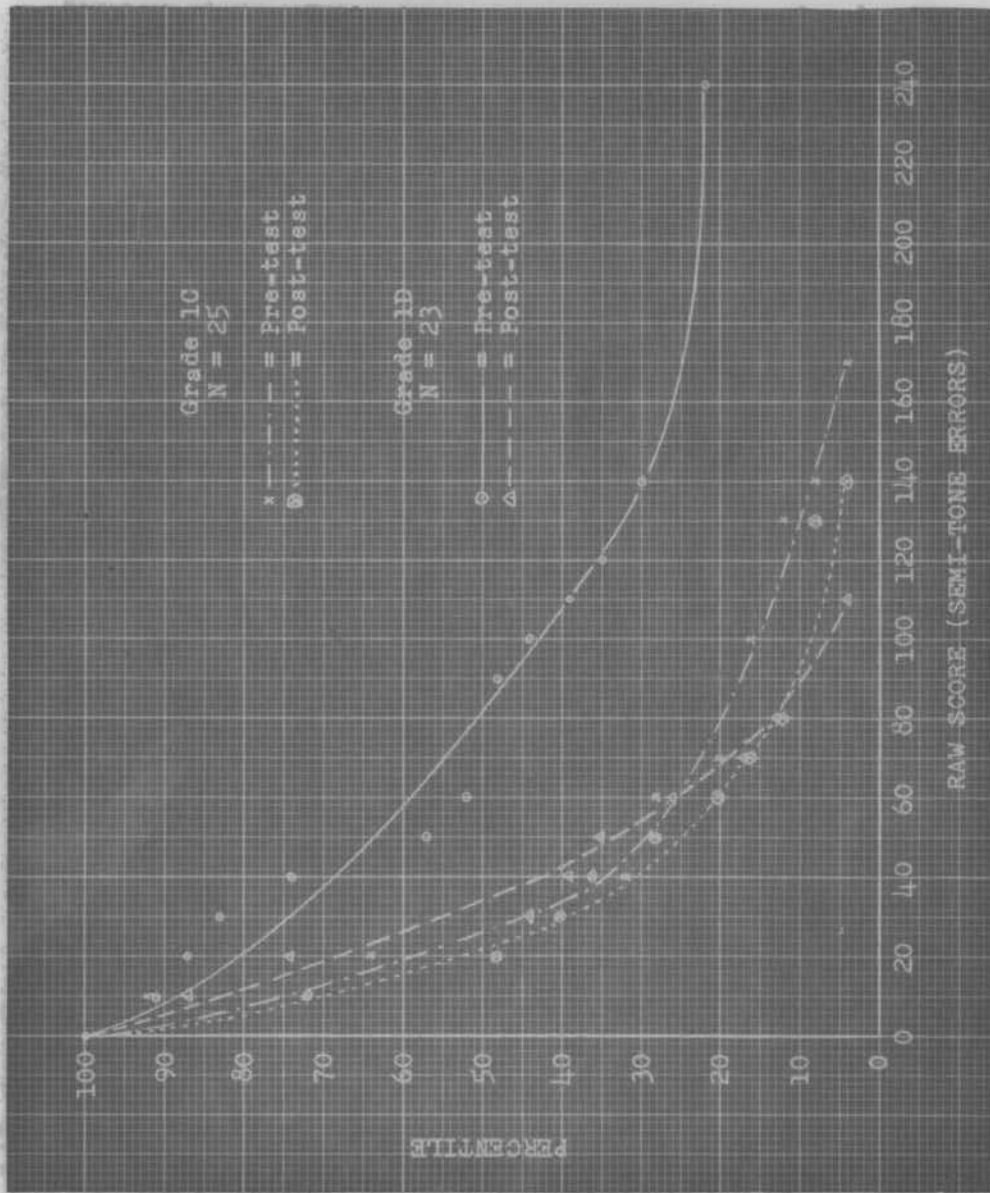


FIGURE 6  
 FIRST GRADE EXPERIMENTAL CLASSES TEST SCORES

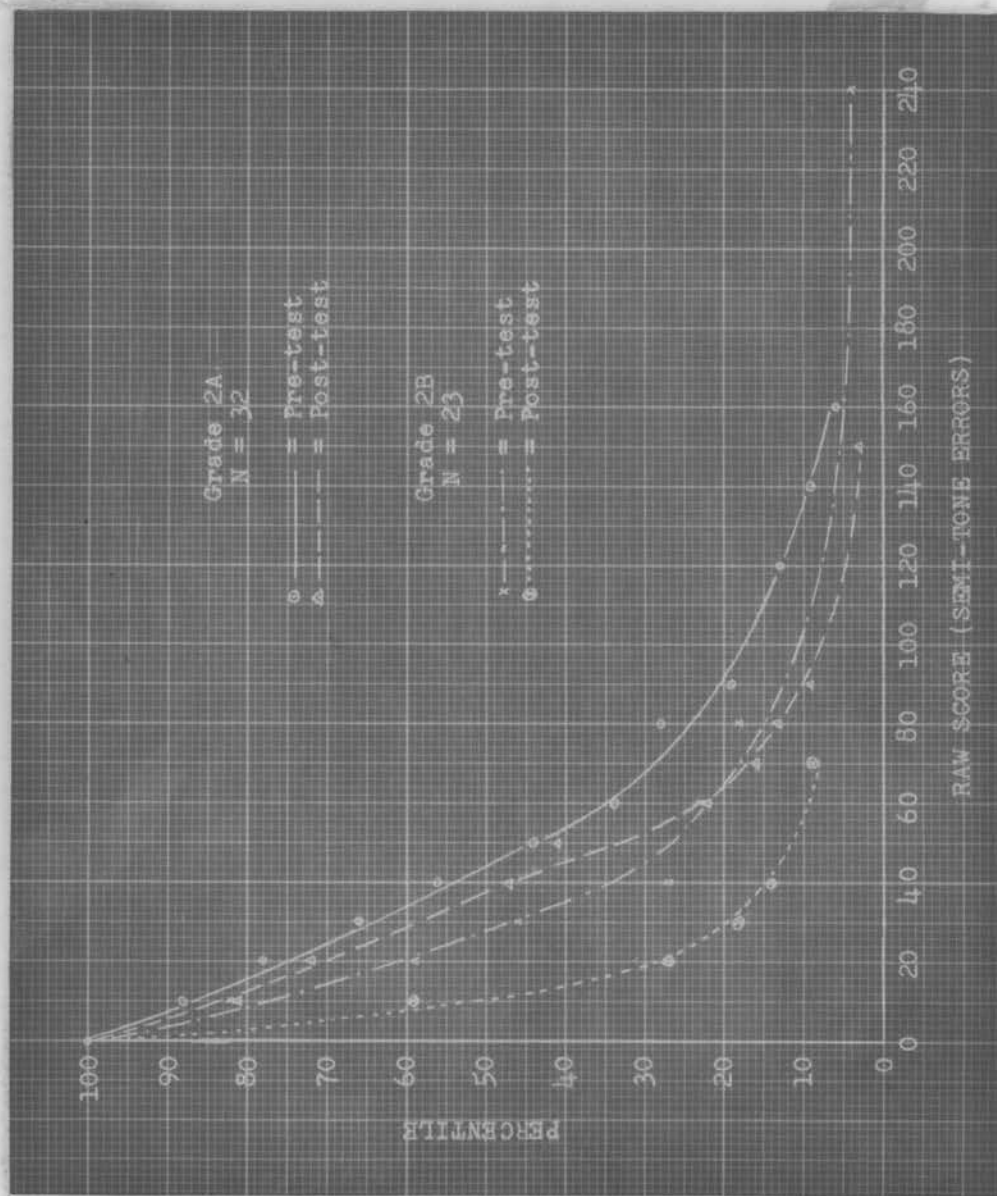


FIGURE 7  
SECOND GRADE CONTROL CLASSES TEST SCORES

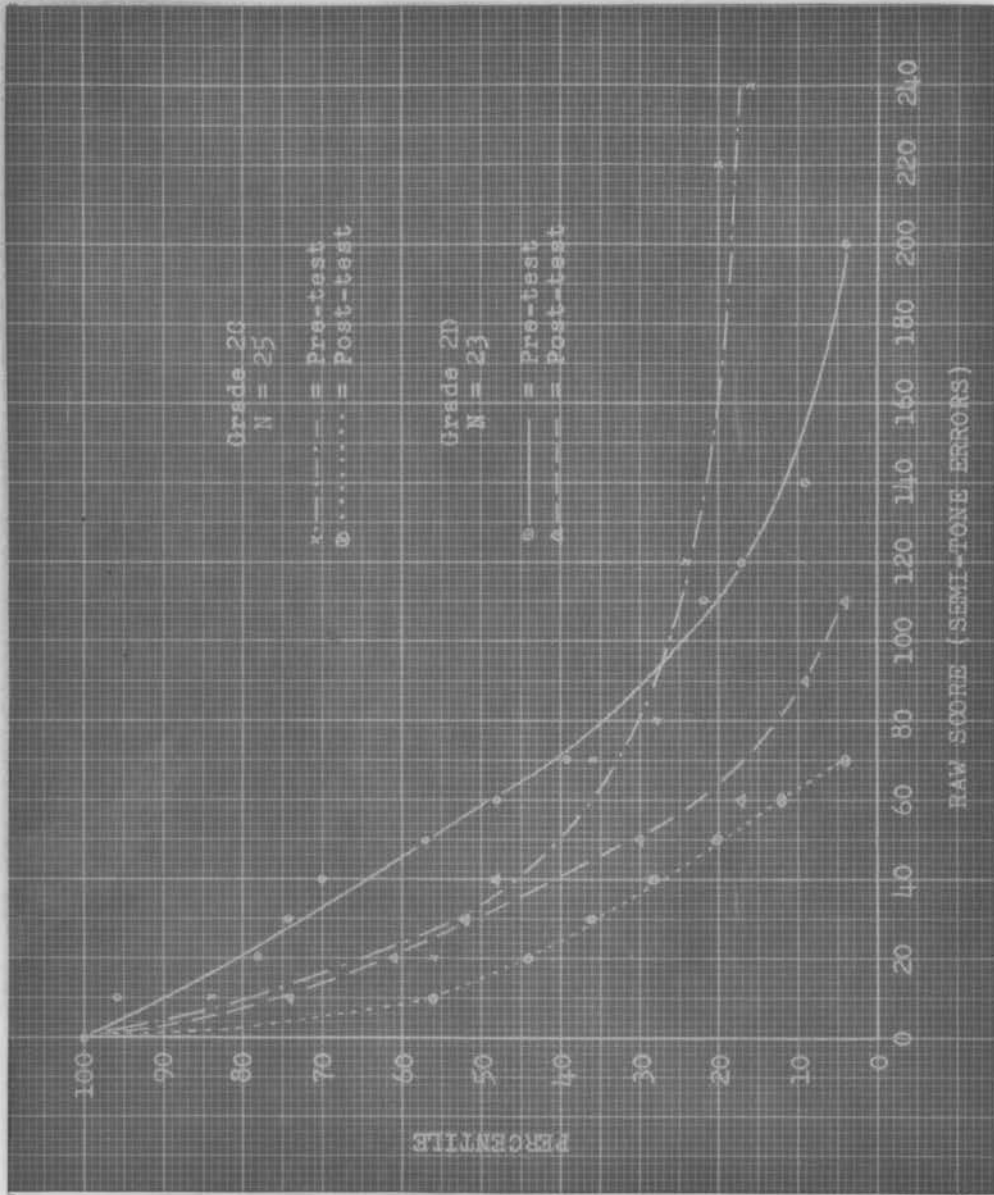


FIGURE 8  
SECOND GRADE EXPERIMENTAL CLASSES TEST SCORES

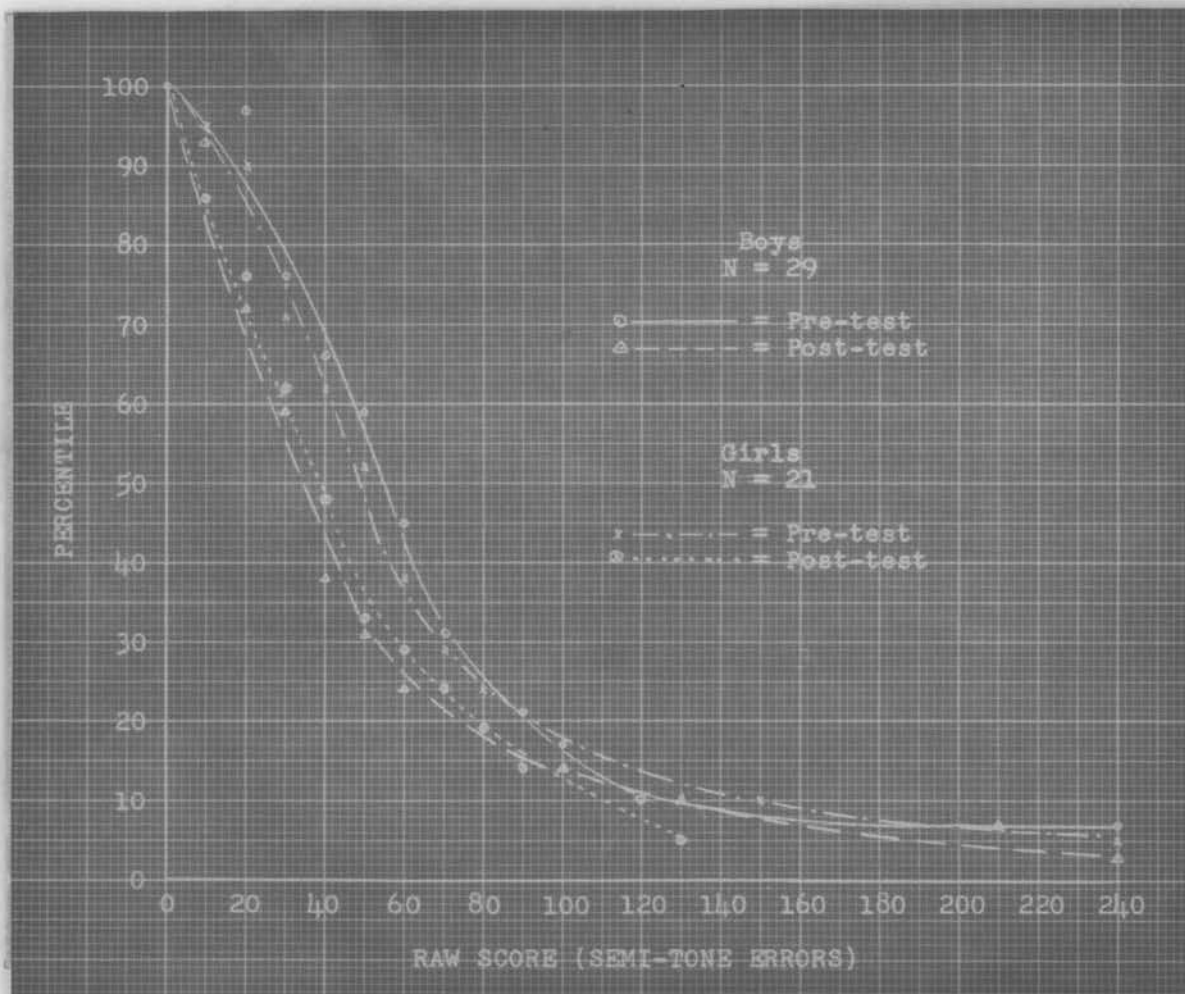


FIGURE 9

FIRST GRADE CONTROL GIRLS AND BOYS TEST SCORES

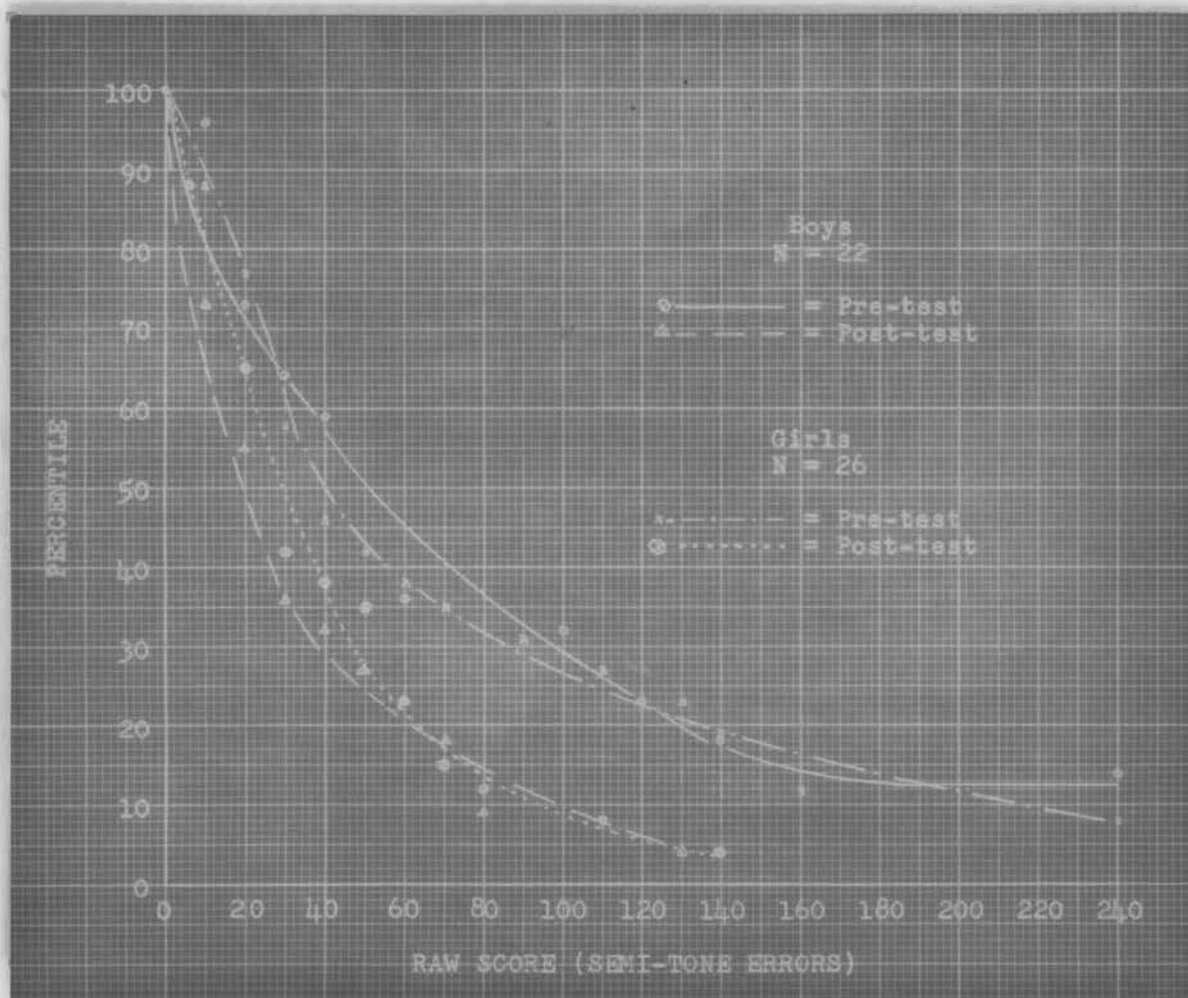


FIGURE 10

FIRST GRADE EXPERIMENTAL GIRLS AND BOYS TEST SCORES

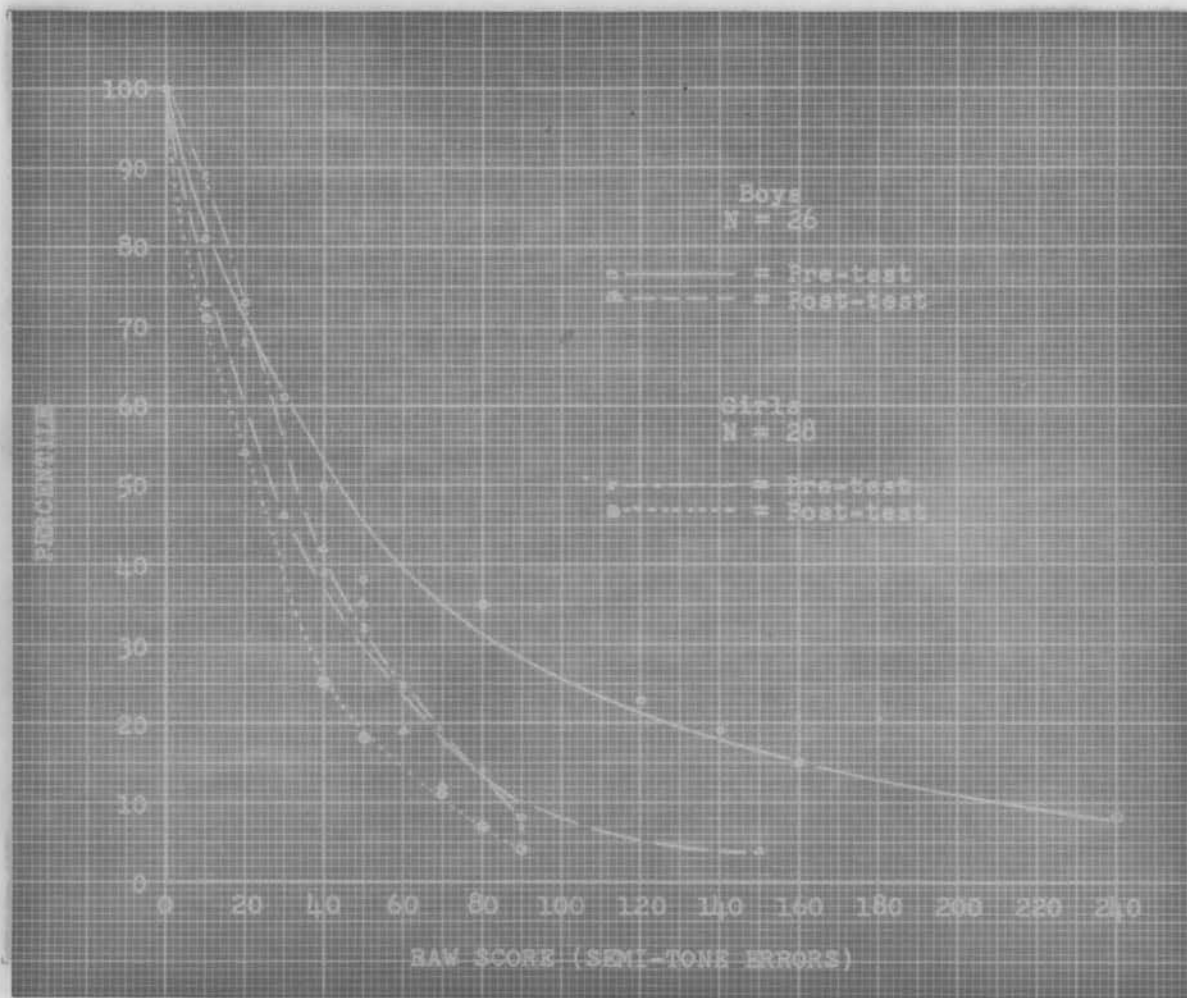


FIGURE 11

SECOND GRADE CONTROL BOYS AND GIRLS TEST SCORES

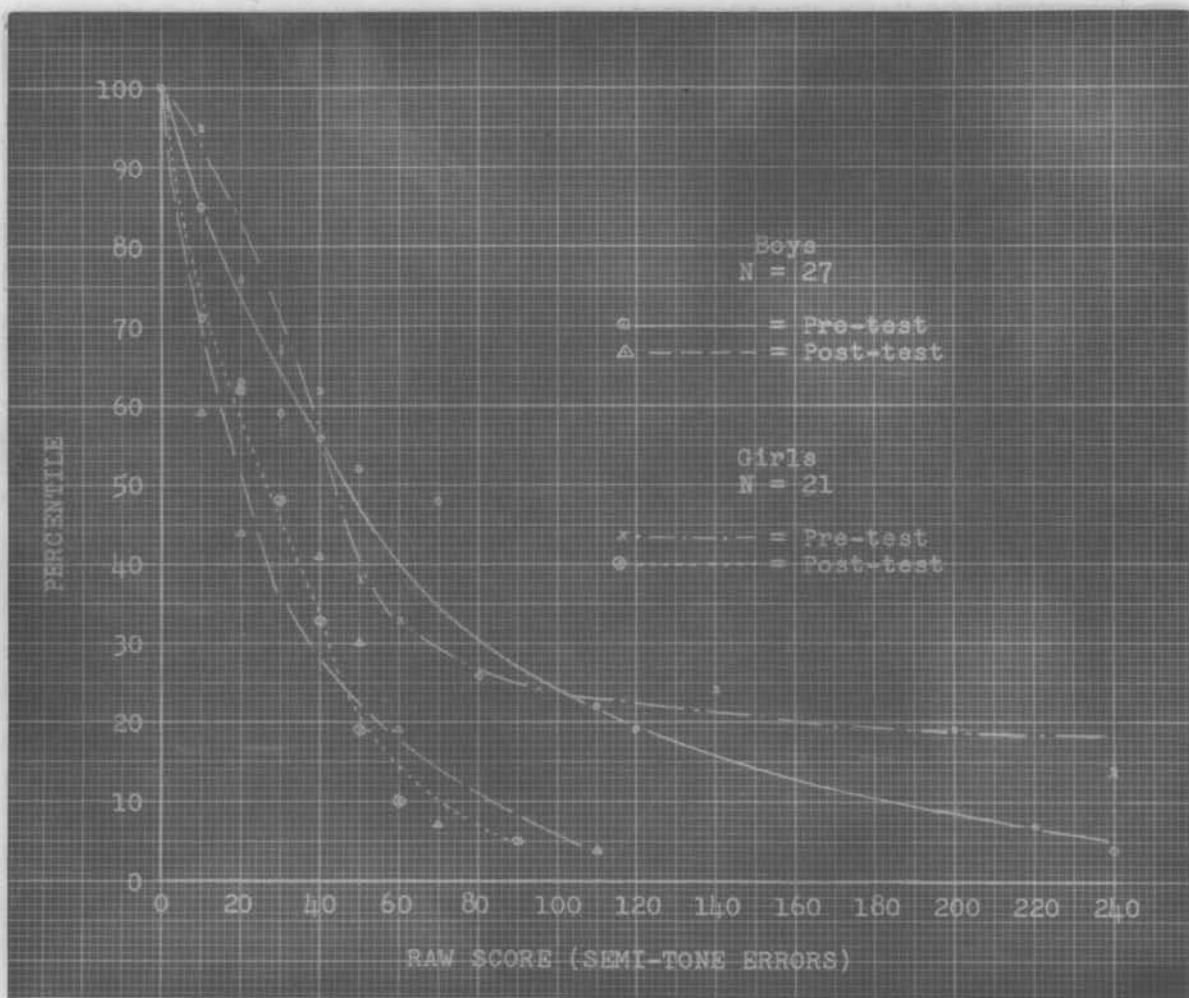


FIGURE 12

SECOND GRADE EXPERIMENTAL BOYS AND GIRLS TEST SCORES