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entitled _____ AN EXPERIMENTAL STUDY OF TACHISTOSCOPIC TRAINING IN _____
_____ READING MUSIC _____

be accepted as fulfilling this part of the requirements for the degree of _____ DOCTOR OF EDUCATION _____

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IN READING MUSIC

A dissertation submitted to
The Graduate Faculty of the Teachers College
of the University of Cincinnati
in partial fulfillment of the
requirements for the degree of

DOCTOR OF EDUCATION

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CHAPTER I

THE PROBLEM

Statement of the problem.-- The major purpose of this investigation is to determine the effect upon achievement in reading music of a type of tachistoscopic training consisting of short exposures of musical units of increasing difficulty.

General significance.-- There are several ways in which this problem is significant. The study may be regarded either as a study in methods of instruction in reading music or as a study of transfer from training in a narrow function to skill in a broader function. The investigation also has applications to both the general psychology of learning and the special problems of measurement of proficiency in the reading of music.

The particular procedure involved is a narrow one, in every way confined and kept to one particular aspect of reading music, while reading music is itself a much broader function requiring attention to many variables not introduced in the study. This involves the problem of a Gestalt approach, in which an activity is taught as a whole and only broken down as necessary, as against a connectionist approach, in which parts are taught and then combined. This latter procedure, which is, in general, that of the present study, assumes the possibility of teaching separately a single aspect of a complicated process.

In order to conduct the investigation it was necessary to arrive at methods of measurement of achievement in reading music. This resulted in the development of a special technique for measuring the reading ability of the instrumental players. This technique constitutes a significant contribution of this investigation.

Musical significance.-- The reading of music is an important tool for the performer and for the thorough understanding and appreciation of the listener. In the instructional phases of the school music program, emphasis is placed upon the meanings of the various notational elements of music. Much printed music is used in the teaching of vocal music classes, while the instrumental music program depends for its very existence upon the ability to read musical notation.

Improvement in the teaching of the reading of music is very desirable. The statement is often heard, "I cannot read music." The study of reading is one of many skills introduced in the limited time allotted to the study of music by an average school program. The time spent in learning to read literature far surpasses that devoted to reading music. The need for improved methods in teaching the interpretation of musical notation is widely recognized in music education. A review of the techniques of teaching the reading of literature yields promise that parallel methods of instruction in music may be devised.

In both the reading of music and the reading of literature, psychological analysis suggests that span of recognition is an important factor in achievement. For many years short-exposure apparatus has been used to study recognition span. In certain recent publications on reading, the use of such apparatus is recommended as a means of increasing recognition span. This study reports an attempt to apply such a procedure to instruction in reading music.

General procedure.-- Experimental and control groups of junior and senior high school pupils were established for purposes of comparison. The experimental subjects were given instruction in the reading of music by the use of musical units written in conventional notation and flashed on a screen for a controlled length of time. This training program was intended to develop increased span of recognition on the part of the subjects. The tachistoscopic training was added to the regular music program for the experimental subjects, the regular program being identical for experimental and control groups.

Achievement in reading music was measured for all groups both before and after the period of training of the experimental groups.

A number of instrumental players were included in the experiment. For these pupils an added measure of sight reading performance was devised and administered before and after training of the experimental groups.

Derivation of the problem.-- In the field of language reading many techniques are used to improve reading. Among these, various tachistoscopic devices are in use and have been

the basis for considerable research. Studies showing the importance of reading span for success in reading literature lead to a consideration of a technique in teaching the reading of music which will develop the reading span. Only slight attempts of this sort in music education appear to have been made heretofore. Such studies as are pertinent will be reported later.

Specific questions raised.-- The study attempts to answer the following fundamental questions:

- (1) What effect has training in recognition of musical materials during short exposures upon span of recognition in reading music?
- (2) What effect has such training upon general achievement in reading music?

A subordinate question involved is:

How can sight reading performance of instrumental players be measured?

Limitations of the study.-- The significance of the experimental results may be limited by the fact that the training program was carried on in only one school. Three hundred and sixteen pupils served as subjects. This number included thirty-two class groups. Six of the class groups were composed of instrumental performers, these numbering seventy-two players in all.

Materials for this type of experiment were a problem. Music printed on lantern slides, suitable and available for general use in this type of training, was not obtainable commercially. All of the slides used were made for this study.

The achievement tests used to measure skill in music reading did not measure what was included in the training material. The tests offer a picture of musical ability in a truly musical setting, whereas the training was restricted to isolated phases of musical ability.

A limitation was imposed by designing all musical materials used in the training lessons of the experimental groups so that the single factor of span of recognition in perception was emphasized. The musical units included in the training lessons comprised half notes only. Such a restriction was considered necessary if width and general outline were to receive primary notice. The contour of melody as a whole was stressed, rather than the variation of note values in particular rhythms. No training in rhythm perception was considered a possibility, in view of the design of the experiment. The training materials did not include any elements of notational instruction. No clef signs, key signatures, meter signatures, bar lines, or accidentals were included. The only use of musical notation made in the experimental lessons was in the materials flashed on the screen, except in the first few lessons when the flashed notes were matched with multiple-response musical units on the response sheets.

The elimination of rhythmic emphasis from the training limited the possible advantage of the experimental groups when reading musical materials. There was no indication of rhythm either in the notation used or in the sounding of the musical groups flashed on the screen.

It was difficult to measure achievement in reading music for most of the groups of pupils, since these pupils could not perform individually in sight reading. The instrumental players, on the other hand, were objectively measured in reading performance. No standardized procedure was found for measuring the other pupils in vocal performance. This fact limited the measurement of the reading of music by the non-instrumental performers to one type of expression in a standardized reading achievement test in music. This test did not require any singing or other musical responses by the subjects.

A limitation in technique was found in the attempt to estimate variation in the span of recognition of the subjects. It was found necessary to assume that span of recognition was being developed when materials of increasing length and difficulty were flashed on the screen and the mean scores of responses maintained improvement.

Assumptions recognized.-- Not all pupils in general music classes of schools are interested in music. Probably fewer pupils are interested in reading music, even though listening may be a pleasure. To make the study of general

value, pupils of very limited reading ability in music were included in the experimental groups as well as others who showed some original reading skill. It was necessary to assume that all the subjects were interested in improvement of reading skill. The lessons given were, by nature of the design of the study, rather formal and difficult for the subjects.

All pupils were encouraged to score as well as possible on all tests used and in all training lessons. No actual grading of accomplishment in reading music was ever used on report cards of the pupils. It was assumed that all scores were valid measures of the skills involved. No reason was noticed for any other assumption.

The instrumental players measured in reading music in the study were also recognized as presenting various stages of interest in music accomplishment. All were assumed to react to the various performance tests in a way to yield a true measure of skill. It was recognized that the individual performance tests of the instrumentalists introduced the element of nervousness over such a situation. All of the players had performed often previously, however, for the experimenter. No reason was noted for the reactions of the subjects to vary because of the emphasis by the experimenter. All measurements were made in the same manner and were objectively recorded.

Value of the study.-- This study is a primary investigation of a limited problem in the teaching of musical

notation. Very little research has been reported in this area. The methodology of music teaching needs experimental treatment. The field of mechanical aids used in teaching reading is one of controversy. This study provides evidence on the advantages and limits of the use of a tachistoscopic device in a general program for teaching the reading of music.

The study promises to promote objective comparison of reading performance by musicians. The reading index established by the instrumental performers may assist future work in this type of measure. Valid measures of reading skill in music must ultimately be based on a performance skill rather than on a reaction skill, as measured today.

As a study of transfer of training, this investigation makes a minor contribution to general psychological literature. Little evidence in the field of music relates to transfer of training.

Plan of the study.-- Chapter I presents a statement of the problem, and of the significance, the limitations, and the values of this investigation. Chapter II analyzes related studies both in the field of general reading of literature and in that of the reading of music. Chapter III describes the procedure of this experiment. The experimental design, choice of subjects, training lessons, and various criteria of achievement are explained. Chapter IV presents the results of the training lessons for the experimental group. The data on development of span of recognition are included. Chapter V

compares achievement in reading music by the experimental and control groups. The data are first evaluated on the basis of the small sample technique. Results are also compared, secondly, in terms of the mean score difference of the groups. The index of sight-reading performance, originated for this study, is used in comparing the reading performance of the instrumental players. Chapter VI provides a general summary, and includes statements on conclusions, applications, and recommended investigations.

CHAPTER II

RESEARCH IN READING EMPHASIZING SPAN OF RECOGNITION

Introduction

This chapter presents an overview of major research dealing with span of recognition in reading. The first section of the chapter reviews research in the reading of literature, while the latter portion deals with research in reading music.

Research in Reading Literature

Relationship of the problem to research in reading literature.-- Research in reading literature covers a wide field.¹ A small portion of this work relates to the span of recognition. This study attempts to use a technique borrowed from the field of method in teaching the reading of literature, in application to teaching the reading of music. The problem of the development of span of recognition is the common ground for this study and general reading research. Research on span of recognition, both in general reading and in reading music, is accordingly reviewed briefly.

Meaning of span of recognition.-- In research devoted to reading there is constant reference to the importance of the span of recognition in the reading process. A clear explanation

¹ William S. Gray, "Reading," Encyclopedia of Educational Research, pp. 891-926. Edited by Walter S. Monroe. Prepared under auspices of the American Educational Research Association. New York: Macmillan Co., 1941.

of the meaning of span of recognition is given by Sandiford:²

The span of recognition is the amount that can be grasped in a single attention span...The span of clear perception is the amount that can be seen at a single glance and must be distinguished from the span of recognition...The span of clear perception is inherited and can not be altered... The span of recognition is always smaller than the span of clear perception. Observers can see more than they can identify.

Research on span of recognition.-- Gray³ found an increase in recognition span through successive school grades. This fact was verified by Tinker,⁴ who found an increase in recognition span from age four to fourteen, with little increase after fourteen years of age was reached.

Gray⁵ found that the span of recognition might be improved if training was undertaken early enough. Emphasis is placed on careful choice of reading materials. Maturity and practice bring an increase in the span. The importance of peripheral vision in language reading is emphasized.

⁶Buswell also notes the eye-voice span to be generally fully developed by grade five and records the stages of growth of

²Peter Sandiford, Educational Psychology: An Objective Study, p. 336. New York: Longmans, Green and Co., 1930.

³Clarence Truman Gray, Deficiencies in Reading Ability, p. 89. Boston: D. C. Heath and Co., 1922.

⁴Miles A. Tinker, "Visual Apprehension and Perception in Reading," Psychological Bulletin, 26 (March, 1929), 223-40.

⁵Clarence T. Gray, op. cit., p. 90.

⁶G. T. Buswell, Fundamental Reading Habits: A Study of Their Development, p. 28. Supplementary Educational Monographs, No. 21. Chicago: The University of Chicago Press, 1922.

the span of recognition. The reading rate and the eye-voice span are shown to increase together. The perceptual demands of mature reading are found to be satisfied with a pause duration of one fifth of a second.

Tinker also reviews the studies on span of perception and finds several investigators to note a correlation of .50 to .70 between span of perception and ability to score on reading tests. As a summary of these reviews it is stated that:⁷

The span of visual apprehension for certain types of material is an important determinant of reading ability.

Reading improvement.-- Some variation is found in the opinions regarding the knowledge of the importance of eye movement exercises and the method to be used in improving reading skill. Fordyce believes that:⁸

Improvement lies in the field of correcting faulty motor-eye habits, for we have found that as the eye is trained to grasp larger and larger units, the perceptual span increases at a corresponding rate.

This view would imply that eye-movement exercises give increased perceptual span. This belief is opposed by Hollingworth,⁹ who believes that there are perception habits

⁷ Miles A. Tinker, op. cit., p. 239.

⁸ Charles Fordyce, "Testing the Efficiency in Reading," Addresses and Proceedings of the National Education Association, 55, pp. 818-21. Washington: National Education Association, 1917.

⁹ Leta Stetter Hollingworth, Special Talents and Defects, p. 61. New York: The Macmillan Co., 1925.

which affect reading efficiency but separates these perception habits entirely from the suggestion that they are eye-movement habits.

Witty and Kopel state: ¹⁰

Research has demonstrated that improvement in eye movement occurs when reading gains are produced by remedial programs which make no direct attack upon faulty eye movement. In fact, eye-movement training in itself has been shown to yield no appreciable gain in reading ability...The assumption that effective reading may be achieved by phonetic drills, eye exercises, or other part-devices, neglects the fact that interest and need should be determinants of method.

Horn states the most extreme view: ¹¹

The classroom teacher needs to be concerned with movements of the eyes little more than with the movements of the bones of the inner ear.

Bond ¹² places the emphasis upon a different point. Faulty eye movements are viewed as a result of inability to read the material. The problem is recommended as one of correcting poor reading techniques of which faulty eye movements are a result.

Whether the improvement in reading efficiency through increase of perceptual span is a problem of eye-movement habits or not, Brooks notes that: ¹³

¹⁰ Paul Witty and David Kopel, Reading and the Educational Process, pp. 17-18. Boston: Ginn and Co., 1939.

¹¹ Ernest Horn, Methods of Instruction in the Social Studies, pp. 201-2. New York: Charles Scribner's Sons, 1937.

¹² Guy L. Bond, and Eva Bond, Developmental Reading in High School, p. 72. New York: The Macmillan Co., 1941.

¹³ F. D. Brooks, The Applied Psychology of Reading, p. 32. New York: D. Appleton and Co., 1926.

The absolute span as measured tachistoscopically is not used in reading. The reading span is subject to training to more nearly its physiological limit.

This points the direction of the program to be followed, for, as Brooks states further: ¹⁴

The tachistoscopic span is the physiological limit determining the upper levels of reading-span development.

Tachistoscopic reading practice.-- Weber ¹⁵ has used tachistoscopic exercises with college students. Practice was given in identifying forms, in reading sense and nonsense materials, and in responding to true-false statements. A residual gain in the experimental group of four per cent in reading comprehension and twenty-four per cent in reading speed was noted. Results also were noted showing the persistence of such improvements with the passing of time. The best materials and procedures for practice work are given. Relations between improvability, general intelligence, and initial reading speed are also stated.

Robinson ¹⁶ also has reported an experiment with college freshmen in which training was given in reading phrases shown for short exposures. The selections used were typed in short separate phrases gradually increasing in length. Reading

¹⁴ Ibid., p. 44.

¹⁵ C. C. Weber, "The Use of Tachistoscopic Exercises in the Improvement of Reading Speed," Psychological Bulletin, 34 (October, 1937), 533-34.

¹⁶ Francis P. Robinson, "An Aid for Improving Reading Rate," Journal of Educational Research, 27 (February, 1934), 453-5.

from normal literature was interspersed with the tachistoscopic training. The rate of reading speed increased fifty-eight per cent and the comprehension accuracy five per cent.

The gains were due to the following factors:

- (1) Sixty-two per cent increase in the width of fixation (span of recognition).
- (2) Five per cent reduction in duration of fixations.
- (3) Sixty-seven per cent reduction in the number of regressions.

The results show that reading-span improvement was a primary cause of the gains in rate. The subjects improved in perceiving words at a glance, reducing the number of fixations. An improved eye-movement rhythm was noted with more constant forward movement of the eyes and few long fixations.

It was also noted that the average reading span of the experimental groups represented only forty-one per cent of their perceptual span. The span of perception in tachistoscopic reading was noted to be about twice that of normal reading. Only in exceptional cases could the reader approximate in normal reading the perceptual span of tachistoscopic reading.

Harris refers to narrow span of recognition as a common cause of slowness in reading. This narrow span is shown to be the result usually of excessive oral reading and drill on phonetic analysis. The recommended practice is

described as follows: ¹⁷

The best kind of practice for broadening the recognition span is to give training in the recognition of words and short phrases as units, by means of tachistoscopic exposure or flash cards...The time of exposure must be less than a half second so as to prevent more than one look at the word...

Further instructions are given for procedures in teaching reading by means of speed devices. ¹⁸

When flashed exposures are used as a method for improving speed of word recognition, there is a possibility that the skill acquired in reading the cards may not carry over to the reading of the same words in connected material...This can be avoided by giving connected reading drill after the flash card drill using the same words.

Harris ¹⁹ also comments on the use of the metronoscope, a machine for systematic short exposures of words or phrases at regular intervals and in a left-to-right sequence, by observing that the fixed speed of the machine may be a draw-back, since good readers vary in ability.

Harris considers motivation of importance in the training program. He states: ²⁰

Experimental evidence indicates that motivated practice produces as much improvement in rate of reading as programs of eye training do, while it has a somewhat more favorable effect on comprehension.

¹⁷ Albert J. Harris, How to Increase Reading Ability, p. 292. New York: Longmans, Green and Co., 1940.

¹⁸ Ibid., p. 263.

¹⁹ Ibid., p. 238.

²⁰ Ibid., p. 296.

Many investigators recommend the use of flash cards or such devices for short exposure drills as the one utilized in this study.

Durrell ²¹ recommends the use of short exposure devices, such that the child has just one look at the word. The time of presentation of tachistoscopic materials is suggested as one-half second. This seems a long exposure in the light of other studies which will be discussed later in connection with the procedure of this experiment.

The use of lantern slides is also suggested by Durrell. ²² A program similar to that attempted in this study is outlined for reading practice.

McBroom recommends the use of the metronoscope. This writer states: ²³

Greater improvement in mechanical reading skills occurs in given periods of time among pupils who have been trained with the metronoscope than with pupils who have not had this training.

A limitation of the metronoscope is also stated: ²⁴

Comprehension of written materials does not always

²¹ Donald D. Durrell, Improvement of Basic Reading Abilities, p. 178. New York: World Book Co., 1940.

²² Ibid., p. 190.

²³ Maude McBroom and Others, Newer Practices in Reading in the Elementary School, pp. 42-5. Seventeenth Yearbook of the National Elementary Principal, Vol. 17, No. 7. Washington, D. C.: National Education Association, 1938.

²⁴ Maude McBroom, op. cit., p. 50.

improve in proportion to improvement in the mechanics of reading performance as a result of metronoscopic training. Drills do not result in a decrease in ability to comprehend what is read, but comprehension improvement is relatively slight.

The flashmeter, manufactured by the Keystone View Co., Meadsville, Pa., was used as a control device in this study. The merits of this equipment are listed as follows by McBroom: 25

The flashmeter may be used for:

- (1) Measuring width of recognition span.
- (2) Testing speed of perception.
- (3) Checking for accuracy during quick perception.
- (4) Detecting faulty reading habits such as head movement, lip movement, and vocalization.

Preventive values are listed for the flashmeter.

The device is claimed to prevent reversals, to prevent lack of interest, to prevent failures, and to help discover potential reading failures.

It is further stated, however, that research still has to determine adequately all of the values of the equipment and also to ascertain how it may be used for the greatest benefit of children learning to read.

The use of tachistoscopic devices is recommended further because the pupil must recognize the printed symbols instantly, and comprehend specific meanings quickly and correctly. Further, it is shown that the pupil must assimilate the specific meanings, integrating and interpreting them in order that he may develop comprehension.

²⁵ Maude McBroom, op. cit., p. 41.

The following statement emphasizing reading speed is given: ²⁶

If reading speed is good, effectiveness depends on comprehension. If comprehension is good, efficiency depends on speed.

Cole ²⁷ recommends a remedial program in phrase reading which was closely paralleled in this study. A lantern slide projector is used with slides prepared by typing words and phrases on transparent celluloid by the use of radio mats. The materials increase in length gradually from five to eight letters and finally to twelve letters on a slide. A darkened room with a screen is utilized.

All of this is very similar to the technique of the present experiment. Exposure, however, is made in the Cole procedure by quick removal and replacement of the dust cap of the projector, although a shutter is recommended. A shutter was used by the experimenter in this study.

It is interesting to note that Cole recommends that practice last not over ten minutes, a restriction also observed in this study.

A feature in the procedure described by Cole, different from that in the present study, is the continued exposure of a full paragraph of writing until all pupils finally read the example.

²⁶Maude McBroom, op. cit., p. 41.

²⁷Luella Cole, The Improvement of Reading, pp. 107-10. New York: Farrar and Rinehart Inc., 1938.

Cole summarizes the possibilities of improvement of reading speed thus: ²⁸

The speed of reading can be markedly increased without loss of comprehension if one is willing to take the reasonable precaution of beginning with material that is easy and interesting and of giving each child the type of drill he needs most.

From the preceding paragraphs, it appears that much help may be expected from the use of mechanical devices for assisting the training of reading. However, Gates,²⁹ in a study on the use of flash cards, cautions against great expectations for the results of such devices. The statement is made that training with flash-card exercises results in increased span of apprehension, increased speed of perception, and more effective eye movements only as long as flash cards are used. The evidence indicates that these desirable habits do not transfer to actual reading in the degree suggested by the advocates of flash cards. The habits developed are imbedded in a situation more or less distinct from that of regular reading.

Gates ³⁰ points out that it should not be concluded that ~~nothing~~ but undirected practice is needed to secure

²⁸ Luella Cole, op. cit., p. 120.

²⁹ Arthur I. Gates, "Functions of Flash Card Exercises in Reading, An Experimental Study," Teachers College Record, 27 (1925), 311-327.

³⁰ Ibid., p. 326; op. cit., p. 326

speed in reading. He adds that flash devices may be useful in their own right, for example, in the development of interest.

It was noticed during the progress of the present study that considerable interest seemed to be displayed, particularly among the instrumental players included in the experimental group. Some pupils commented about the training after considerable time had elapsed. These players were quite interested in developing reading skill.

Buswell considers the stage of development of great importance in establishing proper application of exercises. ³¹

Where short exposure exercises have been tried at the proper stage of development improvement has occurred...The principal difficulties which have been encountered seem to have been due to lack of application of the exercises at the proper stage of development or to lack of a systematic and standardized method of presenting the materials.

Letters vs. words and phrases in reading.--- Gray ³²

has summarized much of the research relative to letters, words, and phrases in reading by saying that the method of reading depends upon the purpose of the reader. For mature readers an outline of the word form is sufficient for reading. The total form is the essential thing, the various determining letters only conditioning the word form. The numbers of items

³¹

G. T. Buswell, Fundamental Reading Habits: A Study of Their Development, p. 139. Supplementary Educational Monographs, No. 21. Chicago: The University of Chicago Press, 1922.

³²

William Scott Gray, Summary of Investigations Relating to Reading, pp. 74-6. Supplementary Educational Monographs, No. 28. Chicago: The University of Chicago Press, 1925.

recognized at one view are greater when they are organized in higher perceptual units. The amount read per exposure is less when reading by words than when reading by phrases. The length of word is not a significant factor in recognition but the grouping of elementary impressions into larger wholes is one of the most essential facts in the growth of recognition span. As a measure of reading ability the span of recognition is most significant. Exercises to increase the span of recognition should be relatively simple, interesting, and related to a familiar field of thought.

Gray states the results of training as follows: ³³

The size of unit recognized in reading may be increased through appropriate training. It is valid to conclude that training may increase span of recognition...A clear cut distinction must be made between span of perception and span of recognition in reading...The span of perception is usually much greater than the size of the unit recognized in reading, the latter may be greatly increased through training...Growth in span of recognition occurs largely in the first four grades. It may also occur as a result of training, in the upper grades, and even in the case of adults.

Comprehension and span of recognition.-- Klapper ³⁴

notes that rapid readers are more intelligent readers. Of course rapid readers must use a wider span of recognition to achieve speed. Starch ³⁵ has determined a positive correlation

³³ William Scott Gray, op. cit., pp. 78-9.

³⁴ Paul Klapper, Teaching Children to Read, p. 19.
New York: D. Appleton & Co., 1915.

³⁵ Daniel Starch, Educational Psychology, p. 284.
New York: The Macmillan Co., 1928.

between span of recognition and rate of comprehension.

Easy and familiar material is recommended to emphasize perception. A balanced use of analytic and synthetic methods is necessary. Details are stressed for some easy words. Training can make the methods of analysis rapid and accurate.

Control of recognition span in reading early is a determining factor in training rhythmical eye movements. Random oscillations cause poor eye rhythms. Wide span of recognition is not sufficient in itself to give efficient reading ability. The rhythmical eye movements are important.

Buswell emphasizes the following essential habits in developing reading: ³⁶

- (1) Accuracy of recognition
- (2) Wide span of recognition
- (3) Speed
- (4) Rhythmical progress of perception along lines
- (5) Accurate returns from the end of one line to the beginning of the next.

Gray summarizes the procedures for obtaining better reading as follows: ³⁷

Speed may be increased through appropriate methods at various levels of school progress...Notable increases in speed drills on comprehension varies with the emphasis placed

³⁶ Buswell, op. cit., p. 138.

³⁷ William S. Gray, "Reading," Encyclopedia of Educational Research, p. 922. Edited by Walter S. Monroe, Prepared under auspices of the American Educational Research Association. New York: Macmillan Co., 1941.

on both speed and comprehension in the training exercises...
Effective methods are:

- (1) Speed drills on short passages
- (2) Short exposure exercises supplemented by speed drills
- (3) Training in rapid reading
- (4) Training to reduce vocalization
- (5) Training to increase span of recognition
- (6) Increasing amount of reading done
- (7) Pacing eye movements
- (8) Developing motives for improvement
- (9) Securing favorable conditions for practice
- (10) Studying factors of success
- (11) Securing persistent practice.

Buswell, as a result of working with adults, makes the following statement: ³⁸

Variations in width of the span of recognition are apparently controlled by an inner process of comprehending words and meanings...If the words are familiar and if the content of the reading material is in a field which is well known by the reader, the eyes take in a considerable amount of material at a single fixation; but, if difficult words and a strange content are met, a detailed examination is required necessitating narrow span of recognition.

Eye-voice span.-- The eye-voice span may be defined as the distance between the eye fixation on a word and the word the voice is pronouncing while reading aloud. This measure has been the subject of research. Buswell ³⁹ states that all good readers have a wider eye-voice span than poor readers. There must be something about a wide eye-voice span

38

Guy T. Buswell, How Adults Read, p. 54. Supplementary Educational Monographs, No. 45. Chicago: University of Chicago Press, 1937.

39

G. T. Buswell, An Experimental Study of the Eye Voice Span in Reading, p. 62. Supplementary Educational Monographs, No. 17. Chicago: The University of Chicago Press, 1920.

which is characteristic of mature readers. Buswell⁴⁰ cites the need for development of specific methods for training the habit of pushing the eye farther ahead of the voice in order that there may be an interpretation of meaning in larger units.

In music the span between the note being read by the eye and the note being performed corresponds to the eye-voice span in literature reading. The experimental training of this study was intended to increase comprehension in span of recognition. It was hoped that such increased comprehension would result in improved performance in sight reading music.

Reading of Music

Notation of music.-- The musical score has been very extensively discussed by Mursell.⁴¹

The musical notation as we have it today is one of the most ingenious and intricate systems of symbolism ever developed. It is a complex of symbols of entirely different types, some being directly representational and others conventional or arbitrary. The score can indicate at least roughly the pitch contour of the music in immediate visual representation. By the use of slurs and the tying together of the flags it can do a great deal to represent visually the lateral as well as the vertical organization of the music. But time signatures, measure bars, indications of tonality, and staccato points, as well as rests, are all indirect or conventional symbols, and are by no means invariably rationally self-consistent. Virtually no experimental research has been carried

⁴⁰ G. T. Buswell, op. cit., p. 63.

⁴¹ James L. Mursell, The Psychology of Music, pp. 251-4. New York: W. W. Norton Co., 1937.

on dealing with psychological processes involved in its apprehension, and so we are thrown back upon general theoretical considerations, and upon analogy with other types of symbolism particularly that of written language...

It would seem reasonably certain that the symbols of the musical score should be apprehended group-wise in terms of their musical meanings. We have repeatedly insisted that the perception of music depends upon aural integration. It is heard and responded to as total configurations of melody, harmony, and rhythm, not as separate notes or intervals or rhythmic unit groupings. The analogy here with language is extremely close, for we hear spoken language as sentences or phrases--that is, meaningful units in sequence, and not as series of words or syllables. And it has been abundantly demonstrated that written language is not read as letters or syllables or words, but again as total meaningful linguistic configurations. The same pretty certainly holds true of the musical score. But here we have an added systematic complication. For while written or printed words are in no sense direct visual representations of their sound, the musical score does represent visually some elements of the aural configuration, while other elements are symbolized indirectly and in a conventional manner. We may assume then that the most elementary and primary apprehension of the score is simply the recognition of the indicated pitch contour. And the next step, very closely associated with it, is probably the recognition of the fundamental lateral organization into phrase-units. Tonality indications such as key-signatures and "accidentals" should function by way of establishing a mind-set...The convention of renewing the signs for accidentals after each measure bar is a point of some psychological interest, for it turns upon the length of time a given mind-set can endure, and the extent to which the incidence of irrelevant symbols will tend to erase it. Time-signatures and measure bars also are conventional symbols whose proper effect we would hold to be the establishing of an appropriate and controlling mind-set or attitude. It would seem that any kind of intelligent pedagogy must be based on such considerations as these, and must center persistently upon the significant total configurations of the notation rather than upon its constituent detail. Of course, the detail is important and cannot be ignored, but it has meaning only in its total setting, and efficiently directs activity only when so apprehended.

The notation has a constant tendency to impose itself upon our thinking about music, and we must constantly remind ourselves that it is both an approximation and a conventional scheme, and that the realities of music are always to be sought in what we hear rather than in the symbolism by means of which we handle the auditory content. Take for

instance the notion of key. Any key is simply a tonality organization about a given pitch level chosen as the tonic and represented by the pure power of two. It is not constituted by four flats or five sharps, for these are nothing but conventional symbols. Any key signature could be written in a great many ways, and we select one of them as best or most typical merely because experience proves that it most conveniently establishes an appropriate mind-set which causes us to interpret the lines and spaces of the staff in accordance with a certain tonality scheme. As a matter of fact we could write music without any recourse at all to the device of the key-signature, though it would not be convenient to do so since it would make the music harder to read...

Another misleading suggestion conveyed by the score is the idea of music as made up of discrete notes. We have seen that the constant tendency of the voice is to dispense with definite discrete pitch-steps and to function in terms of total melodic configurations.

The complex problems in reading music involve one other requirement. In performance, musicians must determine phrasing. Difficulty is experienced in establishing the phrasing, defined as groups of tones which are arranged in a related order so as to give a unified musical idea. Recognition of the elements of a musical phrase in the notation often is a difficult task. The problem is complicated by the unlimited order of rhythms and tones combined with a variety of performance types, such as legato and staccato.

In the reading of vocal music assistance in phrasing is given by the words themselves. In the best vocal compositions the phrasing of words and music is a unity. In instrumental literature of the easier melodic type the phrasing is often obvious, but may be open to variations of interpretation. Such factors as the bar line and the rhythmically longer tones

offer helps, but sometimes are misleading. The tendency for the inexperienced player to phrase at the bar line is a difficult habit to break. The bar line often seems to mark the limit of the length of phrase in the mind of the player, whereas the composer may intend a longer grouping.

Another difficulty is experienced in writing music. Many musical performers find it very difficult to notate the music they would like to write.

As Ortman has shown: ⁴²

By far the greatest number of problems in ear-dictation are not auditory but visual. Pupils normally hear the stimulus correctly but cannot properly transfer it to musical notation.

Comparisons in the reading of music and literature.--

In reading literature regular horizontal movements of the eyes from left to right occur with occasional regressive movements, but with little vertical motion. In music the reading results from zigzag movements gradually moving from left to right. The eye must move from clef to clef in piano, organ, or orchestral scores, and from notes to words in singing. In following the music of instruments the vertical motion of the eyes is very noticeable. The reading of music is complicated through the necessity for maintenance of rhythm and the introduction of interpretation. Performance definitely retards the reading of music. Many musicians can read two or three

⁴² Otto Ortman, "Elements of Chord Reading in Musical Notation," Journal of Experimental Education, 3 (September, 1934), 50-57.

times faster when not asked to perform. Many skilled musicians can read music they are unable to perform, such as that in an orchestral score.

The habits necessary in reading emphasized by Buswell ⁴³ include wide span of recognition, rapid rate of recognition regardless of the size of the unit, and regularity of rhythmic progress of perception along the printed line. Jacobsen ⁴⁴ maintains that the reading of music requires these same habits with the regularity of rhythmic progress of perception to include clef to clef and measure to measure. Span of recognition is influenced by memory. In music one must focus eyes on one group while playing the previous group. Rhythm values must be retained in memory while actually reading the staff location of the note.

Research in the reading of music.-- Bean used a tachistoscope in an experimental project in reading piano scores. The material used was prepared on flash cards with two stimulus cards employed at once. The music was arranged in melodic, polyphonic, and harmonic patterns with an exposure time of one-fifth second. The length of exposure is longer than in many such studies.

⁴³

G. T. Buswell, op. cit., p. 138.

⁴⁴

Ole Jacobsen, "An Analysis of Eye Movements in Reading Music," p. 98. Unpublished Master's thesis, University of Chicago, 1926.

On the basis of his results, Bean recommends as follows: 45

- (1) In reading music look ahead. The amount is dependent on speed. Thus anticipate adjustments.
- (2) Sight read day by day regularly.
- (3) Use a large amount of material within the ability of the player.
- (4) In reading for speed permit no looking back to correct errors just played.

These suggestions are practical ones for the instrumentalist.

Strong says: 46

Good sight reading is not a gift. Scales and chords must be recognized in all positions. Learn to read in advance of the playing, first one measure, then two, three, or a whole phrase.

Sanders also emphasizes reading ahead: 47

In reading music one reads as far ahead as he can mentally realize the music at the moment. At a thorough attentive glance a page of matter (to which music matter can be no exception) can be grasped as a whole and fixed in the memory for the conscious analysis (reading) when the page is withdrawn. To become accomplished readers the first step is visually to realize the printed page of music.

Fairchild introduces an added element: 48

45 K. D. Bean, An Experimental Approach to the Reading of Music, p. 75. Psychological Monographs, 50, No. 6, whole No. 226. Columbus, Ohio: The American Psychological Association, Ohio State University, 1938. Pp. v+80.

46 L. M. Strong, "Facility in Sight Reading," Etude, 60 (April, 1929), 184.

47 H. Sanders, "Eye Training for Music Students," Etude, 39 (October, 1921), 570.

48 Homer E. Weaver, "An Experimental Study of Music Reading." Unpublished doctoral thesis, Stanford University, 1930. Pp. 408.

Look constantly ahead and be able to do a great amount of surmising.

It is to be noted that a musician may be able to anticipate the material he is reading, by skillful analysis and ability to infer what the succeeding passages will be. This is particularly true of arpeggio type passages in which one or two tones of a long series may give the player the clue needed to establish the whole pattern.

Weaver ⁴⁹ has measured the span of recognition in music reading. The greatest extent of reading for each second was determined to be eight notes. Probably the amount read was not as great as thought. By measurement of the amount of overlapping necessary in order to provide for accurate reading, an index of reading efficiency for subjects was determined. The system of determining the number of notes per fixation by dividing the number of notes in the selection by the number of fixations is open to criticism.

Weaver shows the impossibility of reading notes from two staves at once with any degree of accuracy. A low correlation is established between results for vertical and horizontal material. Writing knowledge and playing knowledge of musical materials are not the same thing.

⁴⁹ Homer E. Weaver, "An Experimental Study of Music Reading." Unpublished doctoral thesis, Stanford University, 1930. Pp. 408.

The span of recognition varies with the kind of material presented, with the amount of training, and the method of reporting. The relationship between reading span and the amount of training makes establishment of an accurate mathematical ratio difficult. The eye-hand span in piano performance varies from one to seven notes or chords ahead. The overlapping in playing performance represents the difference between the average number of notes seen at one fixation and the average number of notes performed per fixation pause.

It may be noticed here that even with complete equipment for photographing eye movements the problems of analysis of behavior while reading music are very complex. The irregularity of the musical score accounts for this. Types of musical writing fall into so many patterns that an endless variety of visual effects can be achieved. Repetition of figures and notes is frequent, as in the use of the alphabet in language. Repetition of longer phrases and melodies is less often found. Constant new impulses are presented in the construction of the notation of the musical score.

Buegel⁵⁰ has found the horizontal span for reading music to be less than eight notes. An auditory motor type

⁵⁰ Herman F. Buegel, "Differences and Delimiting Factors in Reading Piano Scores." Unpublished master's thesis, University of North Dakota, Grand Forks, N. D., 1934. Pp. ix + 312.

of reader was found, who filled in the details later.

No obvious difference in success was noticed in reading space or line notes or in the reading of bass and treble clef. Notes in the staff were significantly easier to read than leger line material.

Buegel notes that research in language reading must be substantiated in music before substituting one for the other in findings. Ineffective methods of teaching are the causes of insufficient recognition span in reading music. A relationship between proficiency of performance, proficiency in memorizing, and the recognition span was noted.

Buegel noticed that the movement of eyes in rhythmical or melodic units was more important than a minimum number of fixations per line.

This is true in music because the rhythm of the performance, as in reading aloud, will establish the speed with which the eye reads.

Buegel argues that the reader of music should have a comprehension span such as to permit recognition of complete rhythmical and melodic units. The size of recognition span varies with the proficiency of the group and the type of training. Variation of interpretation was greater in less proficient groups than in advanced groups of performers. Notes are read through organization of single notes into higher perceptual units. The "Gestalt" quality

is an important factor but not the only factor in reading. Some players do not see details, but some do, very efficiently. Certain combinations are recognized by special characteristics such as the reflexive character of notation.

Buegel considers reading ability a specific accomplishment. Ability of musical performance can not be measured by the study of the recognition span, although it is very likely that pupils with a greater recognition span are the better learners.

The last conclusion is particularly interesting in connection with this experiment. Ability in musical performance is difficult to rate objectively, but sight-reading skill can be measured somewhat more accurately. An attempt has been made to study the relationship of sight-reading performance to the results of the training program in span of recognition, in the present study.

Wheelright has contributed to the basic method of printing and publishing music. The findings include the following: ⁵¹

- (1) Spacing is not consistent in children's song materials to indicate time values.
- (2) Patterns of notes are successively compared more accurately when spaced in consistent.

⁵¹ Lorin F. Wheelright, An Experimental Study of the Perceptibility and Spacing of Music Symbols. New York: Teachers College, Columbia University, 1939. Pp. xiii+116.

proportion to time values than when not so spaced .

- (3) Music is sight read and performed at the piano with significantly fewer errors when the symbols are spaced in proportion to their time values than when spaced in the traditional manner.

These suggestions require a new process of printing music. A few selections are shown following the plan suggested by Wheelright. The increased cost of following the spacing plan related to rhythmic length of note will probably prevent such a system from becoming widespread. The variations in effective printing of music can be ascertained easily by inspection of the work of different publishers. As in language printing, there will probably always be considerable difference in size, spacing, and composition of the musical notation. A consistent method of notation would add to reading ease, but it remains necessary to learn to read rapidly and effectively the music already printed in the standard method of notation. This varies slightly with different engravers, musicians, publishers, and printers.

The work of Jacobsen ⁵² clarifies some of the reading problems in music. Special equipment was used to follow eye movements, while the subjects performed musical scores at sight. A low number of regressive eye movements was noted, except in looking at the key signatures.

⁵² Ole Jacobsen, "An analysis of Eye Movements in Reading Music." Unpublished master's thesis, University of Chicago, 1926. Pp. vii+ 107.

The method of estimating span of recognition by counting the total fixations of eyes, amount of time required, and the number of measures contained in the selection, is open to question. This index may be of definite value, but as Jacobsen ⁵³ says:

The observation of note duration affects reading even though the subject may have been able to read faster. The distance the eye preceded the playing was not determined.

An important factor seems not only the number of fixations, but also the length of time for playing the selection. Some see large groups of notes for a longer time and others see smaller groups of notes for a shorter time to achieve the same results in playing. In general the fastest readers are the more accurate readers and slowest readers make the most errors.

Jacobsen recommends an experiment to increase the span of recognition and rate of recognition. Exercises in dexterity of performance are suggested for better results in reading by the musician. The vertical movements of the eyes, because of the area covered, particularly in the piano score, introduce an element in span of recognition not found in other reading. The content of the area rather than the extent is important. The retention ability of the reader influences the size of the span of recognition. In teaching reading it is suggested that a method be used which will secure the desired eye movements rather than to teach corrected eye movements in order to improve reading.

⁵³ Ole Jacobsen, op. cit., p. 98.

One of the difficulties in teaching the reading of music lies in the lack of material progressively arranged according to reading difficulty. Almost all music for instructional purposes is arranged progressively according to the difficulty of performance. However, performance difficulty and reading difficulty are by no means identical.

Summary

The material of this chapter may be summarized under these topics:

- (1) Importance of eye movements
- (2) The study of span of recognition
- (3) Research and opinion on tachistoscopic practice
- (4) Similarity in reading music and literature
- (5) Problems of staff reading

Importance of eye movements.-- Disagreement is found over the question of eye-movement exercises. Some authorities believe that eye-movement exercises improve reading skill (Fordyce). The use of metronoscopic practice is favored by certain writers (McBroom). Other writers believe that eye-movement training is not necessary (Witty, Kopel, Hollingworth, Horn). Faulty eye movement is considered the result of poor reading (Bond). In music, rhythmic eye movement has been found important (Buegel, Jacobsen).

Span of recognition.--- In general, there is agreement in considering the span of recognition to be of importance in reading. The span of recognition has been found to correlate with reading ability (Tinker). Span of recognition has been found to correlate with comprehension of written matter (Starch). Rapid readers have been found more intelligent readers (Klapper, Starch). Speed in reading has been found dependent upon the accuracy and width of the span of recognition (Buswell, Gray). Improvement in span of recognition has been accomplished by training (Gray, Buswell). It is believed that span of recognition develops with maturity and training (Gray, Tinker, Buswell, Brooks). Narrow span of recognition is believed a common cause of slowness in reading (Harris). Practice for improvement of span of recognition is recommended (Gray). This view is also favored in development of the reading of music (Bean, Weaver).

Tachistoscopic practice.--- Research and opinion vary somewhat in consideration of the values of short-exposure practice. Tachistoscopic reading practice has been noted to increase reading speed (Weber, Robinson). Other authorities recommend this type of practice (Harris, Durrell, McBroom, Gray). However, it is stated that motivated practice in reading also produces gains in rate of reading and a more favorable effect on comprehension (Harris).

Tachistoscopic devices, in general, are recommended, because the pupil must recognize the printed symbols instantly, and comprehend specific meanings quickly and correctly.

A number of authorities favor a practice series of lessons similar to those in this study. This is recommended for literature reading (Durrell, McBroom, Cole). The use of lantern slides, as in this study, is favored (Durrell, McBroom, Cole). The flashmeter also is suggested (McBroom, Cole). In the field of music, tachistoscopic practice has been recommended (Weaver, Bean, Jacobsen).

The limits of short-exposure practice have been shown in the lack of transfer to actual reading situations (Gates). The practice was shown to increase span of apprehension and speed of perception only while the practice situation was continued. It has been stated that reading ability in music was a specific accomplishment not measured by a study of the span of recognition (Buegel).

A possible explanation of the differences of opinion may be found in the belief that failure of short-exposure exercises may be due to lack of application of the training at the proper stage of development or lack of a systematic and standardized method of presenting the materials (Buswell).

Similarity in reading music and literature.-- A wide eye-voice span has been found a characteristic of good readers (Buswell). Emphasis on reading ahead in music relates to

the eye-voice span. Reading ahead is stressed by musicians (Bean, Strong, Sanders). Reading of music and literature has been compared and contrasted (Mursell, Jacobsen, Buegel).

Notation of music.-- A major problem in music education arises in the case of students who receive the musical stimulus correctly, but transfer the sounds to written notes incorrectly (Crtman). The method of notation of music has been found very complex (Mursell, Buegel, Wheelwright). Some recommendations have been made for adopting changes in writing music (Wheelwright).

Unsolved problems.-- A study of development of span of recognition, such as is attempted in this experiment, has been recommended (Jacobsen). Research in music on this point is not conclusive. Research in the reading of literature has not established complete agreement over the value of short-exposure exercises to develop reading ability. The same problem remains in the reading of music. Transfer from training received in tachistoscopic work to useful situations remains a problem for further analysis.

The reading of music is a major field of investigation. An adequate reaction response is needed. Some measure of sight-reading performance will be useful. This study attempts to answer some of these problems in music education.

CHAPTER III

PROCEDURE

Introduction

This chapter presents the experimental procedure. The major topics treated are the design of the experimental program; the choice of subjects and groups; the apparatus used; the technique of training; criteria for improvement in recognition of the musical excerpts; general criteria for measurement of achievement in reading music; special criteria for measurement of achievement in reading music by instrumental players.

Design of the Experiment

The experimental method.-- This study used the equivalent groups method in an attempt to measure the effects of a particular mode of training in reading music. Experimental and control groups were established on the basis of initial status in reading achievement in music. Pupils equated on the basis of original test scores were assigned to experimental and control groups by random selection. Appropriate tests were used to determine reading achievement in music. After division of the pupils into groups, the experimental classes were given training in reading music by a particular method. At the close of the training period all the pupils in the experimental and control groups were again measured in achievement in reading music. Comparison of the

experimental and control groups in reading achievement . . . was possible on the basis of these scores.

Controlled factors.-- It was attempted in this study to introduce only one variable factor. The single variable factor introduced in the experience of the experimental groups was in the particular training program followed. All materials ready by the subjects in the experimental groups in the training lessons consisted of musical excerpts flashed on a screen for brief, controlled periods. These sets of musical examples were designed to give training in reading phrases gradually increasing in length. It was intended to give training that might increase the span of recognition in reading music.

No other special training in music reading was provided for any of the subjects during the training lessons. However, all the pupils included in the experimental and control groups attended the regular school classes in vocal music instruction and received a certain amount of practice in reading music under conventional conditions. No special instruction in sight-singing was given in these classes, although the children did read a great many songs.

Determination of results.-- A measurement of reading achievement in music was made for all pupils before and after the training lessons of the experimental groups. Data were gathered measuring the progress of the subjects in the experimental groups during the training lessons. The results to be reported include both the data from the training

period, for the pupils in the experimental groups, and the initial and final test data for the pupils in both the experimental and the control groups.

Choice of Subjects and Groups

Locale of the experiment.-- All of the pupils included in this study were pupils of Western Hills High School, Cincinnati, Ohio. This institution includes a combined junior and senior high school of about twenty-five hundred pupils in grades VII through XII.

Groups included.-- Members of the general music classes of grades VII and VIII, together with pupils from the school orchestra and band, were included in this study. At the time this study was conducted the pupils of grade VII were grouped into four classes of boys, and four of girls. This sectioning was based upon sex, intelligence as measured by the Otis tests, and general school achievement as judged by the elementary schools from which the pupils came.

The pupils of grade VIII were grouped in similar classes which had been previously established in grade VII. Adjustments in individual cases had been made, so as to take into account achievement in the previous year of school. Sex differentiation was maintained as before.

The players of instruments included in the experiment were members of the school orchestra and band. These pupils were of mixed grade levels from grade IX to grade XII.

Both boys and girls were included. All instruments of the various types played in a full band and orchestra were represented.

Choice of subjects.--- Before subjects for the experiment were finally selected, all pupils in grade VII, numbering 312 boys and girls, all pupils in grade VIII, numbering 307 boys and girls, and all orchestra and band players, numbering 114 boys and girls, were given the Knuth Achievement Test in Music, Division III, Form A. Information was also gathered showing which students were studying music outside of school with private music teachers.

To avoid the possible influence of the private study of music upon achievement in reading music, no subject was selected for the experimental or control groups of grade seven and eight who was receiving music instruction outside the regular school music classes which all pupils attended. This limitation removed the names of ninety-seven pupils from further consideration.

In the group of instrumental players, practically all of the pupils were receiving added instruction in music, either by private teacher or in a school ensemble group. No pupil was included in this study from these groups who was not receiving added instruction in music, beyond that given in the general music classes of the school. The effect of all the instruction received by these pupils, whether in school or outside, was to be considered in the measurement

of reading accomplishment by these players. A special technique of measurement for this purpose was developed by which the reading achievement of these pupils was measured in actual performance on instruments.

The selection of pupils was so made as to neutralize the possible effect of outside musical instruction. As a result of the methods of selection employed, the pupils in the instrumental groups were all receiving outside musical instruction and the remaining pupils were receiving no outside musical instruction. Thus, the pupils selected from grades seven and eight were free from the possible indefinable effect of sight-singing lessons. In the case of the instrumentalists, on the other hand, every lesson includes, by the nature of instrumental work, some sight-reading instruction. Since most of the instrumentalists were receiving private instruction it seemed better to include those pupils who were studying privately rather than those who were not studying privately.

Division into experimental and control groups.--

It was found that only five of the seventh grade groups could be included in the training lessons planned, because of scheduling conflicts. It was possible to include eight of the home room groups in grade eight, and also all band and orchestra players.

Within each home room group of grade seven and eight, lists of names were prepared for 216 pupils whose scores

matched perfectly on the Knuth test. After these lists were prepared, 104 other names were added. These were pupils whose scores varied slightly from an exact match. These additions were made to increase the total number of names. Data for sixty-eight of the individuals whose scores were imperfectly matched were finally included in the results. The inclusion of the extra cases affected the central tendencies and variability of the distributions of initial scores for the matched groups only slightly. Data showing the degree of correspondence between the matched groups will be presented in a later chapter.

After the lists of names were prepared, with paired cases together, each pair was divided, one member being placed in a control group of pupils and one in the corresponding experimental group. To assign these subjects, the technique of random selection was followed, as recommended by Lindquist.¹ A table of random numbers² furnished the basis for this assignment of subjects to the experimental and control groups.

In the original class groupings of these pupils, the members of each class were all of the same sex, and were selected for general similarity in intelligence and academic

¹ E. F. Lindquist, Statistical Analysis in Educational Research, pp. 24-9. Boston: Houghton Mifflin Company, 1940.

² Ibid., pp. 262-4.

achievement. The primary basis for matching was, however, equality or near-equality of score on the Knuth Test.

After pairings were made, eighty-three pairs of pupils were included in the five pairs of groups from grade seven, and seventy-seven pupils were included in the eight pairs of groups from grade eight. This made a total of 160 seventh and eighth grade pupils in the control group and an equal number in the experimental group.

Instrumental students.-- The instrumental players of the band and orchestra were also matched on Knuth Test scores and in addition were matched on the basis of the particular instrument performed. These players were not matched, however, in sex or grade level. The pairings, according to instrument performed, included two pupils playing trumpet, two playing violin, etc. For the purpose of measuring reading performances, this matching basis was considered particularly important. The Knuth score pairings were imperfect in twenty-two of the forty pairs finally selected. The variation was small, however, between the paired scores. By the use of the random number technique of assignment, the matched pairs were divided into control and experimental groups. Data showing the similarity of the paired groups will be presented in a later chapter.

Number of subjects finally included.-- The limitations imposed in the equating of the pupils considerably lowered the number of cases available, as already noted.

The number of subjects finally completing the experiment was lowered by other factors.

Withdrawal of pupils in either the control or experimental groups reduced the numbers. Extended absence during the twenty-training periods affected the total. No incomplete data were included in the final analysis of results. Data for pupils who missed training lessons, or who, at the close of the experiment, had records that were incomplete as to any scores or tests, were not included in the results. Fifty-seven pupils from grade seven, sixty-five pupils from grade eight, and thirty-six instrumental players finally completed all training and tests. The study used the data from these 158 pupils in the experimental group and from the pupils paired with them in the control group.

Table 1 presents a classification of subjects by classes and sex. This table shows that a total of sixteen pairs of classes were included in the experiment, with 158 pupils in the sixteen experimental classes and an equal number in the sixteen control classes.

Exposure equipment.--- In arranging the exposure apparatus used in this experiment, full consideration was given to the requirements established by Wundt and Dodge, and reported by Whipple.³ The essentials of a good tachistoscope are given as:

³ Guy Montrose Whipple, Manual of Mental and Physical Tests, p. 264. Baltimore: Warwick and York, 1910.

TABLE 1
NUMBER OF SUBJECTS INCLUDED IN EACH EXPERIMENTAL
AND CONTROL CLASS

Pair	Grade or Group	Experimental		Control		Total
		Boys	Girls	Boys	Girls	
1	Grade 7	12		12		24
2	Grade 7		10		10	20
3	Grade 7	11		11		22
4	Grade 7		11		11	22
5	Grade 7	13		13		26
6	Grade 8	6		6		12
7	Grade 8		12		12	24
8	Grade 8	7		7		14
9	Grade 8		14		14	28
10	Grade 8	7		7		14
11	Grade 8		9		9	18
12	Grade 8	7		7		14
13	Grade 8		3		3	6
14	Instrumental	9	4	11	2	26
15	Instrumental	8	3	10	1	22
16	Instrumental	7	5	8	4	24
Total		87	71	92	66	316

1. Exposure is short enough to preclude eye movements.
2. Arrangement of fixation mark and stimulus is such that all parts of exposed object are seen with at least equal distinctness. The exposure field must coincide with the ocular field of direct vision.
3. The exposure of all parts must be simultaneous. No time differences may occur in various parts.
4. Retinal adaptation is favorable; sudden changes from dark to light are avoided.
5. Persistent after images must be avoided.
6. Duration must be limited, to preclude roving of attention over the exposure field.
7. A ready signal must be given.
8. Relative illumination of pre-exposure, exposure, and post exposure fields should be capable of experimental modification.
9. The exposure must be noiseless and free from distraction.
10. It should be possible to arrange for monocular or binocular observation.

The flashmeter, manufactured by the Keystone Co., Meadville, Pa., was used as the control in projecting the materials exposed on the screen. This device meets the specifications established by Wundt and Dodge. The exposure can be regulated so that light can be allowed to flash upon a screen suddenly. The image can be shown for a length of time from one twenty-fifth of a second up to one second, with the added possibility of time and bulb exposures. The mechanism consists of a specially constructed series of interlocking shutters, heat resistant, and controlled by a cable shutter release as on an ordinary camera shutter. This light control is then placed over the lens of a standard lantern slide projector and operated by the attached cable.

Length of exposure.--- After preliminary experimentation and a review of pertinent research, an exposure of one hundred sigma (one-tenth of a second) was used for the experimental training work. Considerable attention has been given to the problem of length of exposure in tachistoscopic studies in eye training. Tinker ⁴ states, "An exposure of 100 sigma prevents occurrence of any eye movements during exposures and yields valid results." Regarding the length of time of exposure to be chosen, Tinker ⁵ says, "A change of exposure interval in which duration of exposure is kept within 40 to 160 sigma would not influence perceptual span significantly."

In an early study Cattell ⁶ found that letters or words must work on the eye from .01 second to .07 second, with a shorter time required for words than for letters. In some cases short phrases or sentences were read as quickly as words or letters. It seems probable that this same situation would prevail in the reading of music by an experienced musician.

In a series of reaction time studies, Dodge ⁷

⁴ Miles A. Tinker, "Visual Apprehension and Perception in Reading", Psychological Bulletin, 26 (March, 1929), 223-40.

⁵ Ibid., p. 227.

⁶ J. W. Cattell, "The Time It Takes to See and Name Objects," Mind, 11 (January, 1886), 63-65.

⁷ Raymond Dodge, "The Reaction Time of the Eye," Psychological Review, 6 (September, 1899), 477-83.

found that an exposure of .1 second could be used without any danger that the subject could move the eyes and obtain a second clear fixation while the material was exposed.

These studies determined the length of exposure to be used. Early trials were made with small groups of students. One large group in a University of Cincinnati class in educational psychology was used for a general trial of the scheme, including the determination of the exposure length, forms to be used, and makeup of slides. The one-tenth second exposure was found to be long enough for reading the slides. After further trials and tests with musicians and students from the Cincinnati Conservatory of Music, the physical arrangements in the following paragraphs were standardized. They were maintained without change, through all the training given the experimental subjects.

Fixation and stimulus.--- The screen was arranged so that the fixation was constant. The exposure was centered for each slide at the same location on the screen so that the eye could find this area and be ready for the stimulus. The brilliance of the exposure was constant and of equal distinctness at all points. This was easily managed since the projection bulb continued to burn at all times. Only when the shutter was opened could the light show on the screen, however. The exposure area was large enough so that any difference in illumination of different parts of the screen was negligible.

Seating arrangements.-- The subjects were seated so that direct vision of the entire screen was possible. The arrangement of chairs permitted some variation in position at different lesson periods. Students were allowed to seat themselves in positions which they considered comfortable and desirable. While a fixed seating arrangement was not required at various lessons, it was noted that little change of seating occurred. This arrangement was based on the work of Griffing⁸ who worked with large classes from grade school through college on the problem of the "extensive threshold." It was noted in this work that the subjects unfavorably seated were no less successful.

The pupils were seated at distances varying from fifteen to twenty-five feet from the screen. The equipment was placed in the same position for each period of work.

Lighting conditions.-- Sufficient light was maintained in the classroom to permit marking of the response forms. Sudden changes from dark to light were avoided. No persistent after images were observed. By the use of shades, the illumination in the room was maintained at about the same brilliance for all lessons. The relative illumination of pre-exposure, exposure, and post-exposure fields was thus

⁸ Harold Griffing, "The Development of Visual Perception and Attention," American Journal of Psychology, 7 (January, 1896), 227-36.

possible of experimental modification. When the conditions for lighting were finally established, every attempt was made to maintain the original situation. No experimentation in illumination was introduced because of the possible variation which could follow.

The exposure sound of the flashing device caused no distraction. The click was as subdued as the sound of the average camera shutter. Since this click was followed in general by the sound of the piano, no notice was given to the shutter sound.

The projector was a standard 9 x 12 cm. lantern-slide projector manufactured by Bausch and Lomb, using a 500 watt bulb and a ten-inch lens. Standard $3\frac{1}{4}$ x 4 inch glass slides were used. The projector opening was located twenty feet from the screen and forty inches above the floor.

The exposure duration of one-tenth second was too short to permit any movement of the eyes.

The ready signal.-- The preparation of the subjects for the exposure offered a slight problem. In order to be certain that attention was centered on the screen at the time that the musical pattern was projected, it was found necessary to repeat the words, "Ready, now!" before each exposure. This sequence of preparatory direction and exposure was kept rhythmically constant throughout the work,

even though Tinker, Roberts, and Jackson⁹ have found the time between the preparatory signal and the release of a tachistoscopic shutter to be relatively immaterial. After determining the perceptual span of the subjects in the experiment these investigators found that there was no significant difference between a series of exposures in which the time from the ready signal to the release of the shutter was kept constant and a series of exposures in which the time was varied.

The screen.-- A standard aluminum painted cloth screen was used. The size was six by six feet with the top edge eight feet from the floor. The portion of the screen used for the exposures was centered in this area. The actual size of the bright area was one by three feet, centered on the screen four feet from the floor. The musical notation centered in this bright area. The length of the staff shown varied from twelve inches to twenty-four inches depending on the number of symbols. The height of the staff was constant at nine inches. In the construction of the slides, the music was centered on the glass so that projection would place the notation at exact center of the bright area of the screen.

⁹ M. A. Tinker, D. Roberts, A. Jackson, "Definite and Indefinite Preparation in the Visual Apprehension Experiment," American Journal of Psychology, 42 (January, 1930), 96-100.

The area immediately surrounding the musical notation was illuminated. This was based on research of Cobb and Geisler,¹⁰ who found that when the surrounding field of exposure was brighter the visual discrimination was better than when the surrounding field was dark.

Binocular observation was used throughout the experiment. All conditions for viewing the exposures were arranged to be as normal as possible.

Preparation of slides.--- A lantern slide was prepared for each pattern of musical notes to be flashed on the screen. A Corona typewriter, musician's model, was used in typing the slides. The typing was done on cellophane. Standard carbon mats were used to enclose the cellophane.

The use of this equipment guaranteed that all material would be printed with equal legibility. Accurate spacing was arranged in accordance with the schedule indicated in Table 2. The musician's model typewriter produced clear, sharp prints, which resulted in a black print on the screen. Black print on a white ground has been found by Taylor¹¹ to be read faster than white print on a black ground.

All notes were written as half notes. No variation in rhythm was introduced.

¹⁰ P. W. Cobb and L. R. Geisler, "The Effect on Foveal Vision of Bright Surroundings," Psychological Review, 20 (November, 1913), 425-47.

¹¹ C. E. Taylor, "The Legibility of Black and White Print," Journal of Educational Psychology, 25 (November, 1934), 561-78.

TABLE 2
SPACING ARRANGEMENT FOR SLIDES

Number of Notes	Spaces	Length in inches	Inches from each edge
2	5	$1/2$	$1-3/4$
3	7	$11/16$	$1-5/8$
4	9	$7/8$	$1-9/16$
5	11	$1-1/8$	$1-7/16$
6	13	$1-5/16$	$1-5/16$
7	15	$1-1/2$	$1-1/4$

All spacing of materials was controlled so that the notes were located exactly between the staff lines or centered on staff lines. The maximum range of notes presented was from the line below the staff to the line above the staff, inclusive. No clef sign was used on the staff.

All the note sequences presented in the training program are shown in Appendix B.

Training Program for Experimental Subjects

Design of materials used.-- The training of the subjects in the experimental groups consisted of reading, or attempting to read, sequences of short musical units presented individually for periods too brief to permit eye movements. The units varied in difficulty, with a gradual increase in the number of notes per unit and in the maximum musical interval per unit. This increase in difficulty characterized both the units presented at each practice period and the materials included at successive practice periods. Success of the subjects in reading the units presented was measured by responses which they wrote on prepared forms.

The units, which were presented on lantern slides, varied in length from two to seven notes and in range on the staff from a unison (single staff line or space) to a ninth (total of nine lines and spaces on the staff, counting

both limits). By changing the length, direction, and range of the musical units, it was possible to prepare 600 slides, each one different from all others.

A more extended analysis of the musical units used in the 600 slides is provided in Chapter IV.

No attempt was made to keep the difficulty of materials or the mode of response constant. The demands made upon the learners by the practice material varied from practice period to practice period. In some cases materials presented at one lesson were repeated at another. Since there was no desire to develop learning curves, these variations in the learning situation were not believed to detract from the purpose of this study. The variations were employed for reasons which will be discussed as the program is described. On the other hand, the program was such as to indicate rather conclusively whether pupils were able, at the close of training, to recognize the relationship of visual musical units to corresponding auditory units. Musicianship is a matter of hearing or producing music.

General plan of lessons.--- After all preliminary testing was completed and groups were chosen, the training program was undertaken. Twenty-one lesson periods were given, one each week. The lessons consisted of forty exposures each and were of approximately ten minutes' duration. Each exposure was for one-tenth of a second.

Lessons I to V.-- The first five lessons differed in certain respects from the remaining lessons. The first five lessons may be regarded as introductory and preliminary to the main period of training. During these early lessons, the mode of response was different from that demanded later. It was also different, during this initial period of work, for the groups of instrumentalists and the classes of seventh- and eighth-grade pupils.

For the first five lessons, a special form was prepared for the subjects in grades seven and eight. On these forms (Appendix E) each of the forty musical selections exposed on the screen was included in a group of four multiple choice musical items. The selections were arranged and grouped in a variety of ways so that the responses called for full inspection of the items as arranged on the form.

The intention of this phase of the training was to draw attention to detailed differences in musical notation of various patterns and to increase the span of recognition by increasing the length and complexity of the musical patterns. No tone production was presented in these lessons.

During these same five lessons, the musically trained instrumentalists were given forms consisting of staves prepared for the writing of the musical pattern exposed on the screen (Appendix D). These subjects were asked to write the actual musical patterns which were shown. The same patterns were exposed on the screen for all training lessons

of both the instrumental groups and the seventh-and eighth-grade groups.

The musically experienced instrumental groups were expected to benefit from the training in writing the detailed musical notation. Again, no actual musical tone was presented in these early lessons for the instrumental groups.

Other lessons.-- From the sixth series of forty exposures through the final twentieth series the members of all the groups were asked to respond in the same manner. Immediately after each musical pattern was exposed on the screen a pattern was played on the piano. The phrase performed was either identically the same as the exposed phrase on the screen, or differed in some detail. The registration of treble clef was used and the first tone was always the same as the note in the flashed pattern.

For all of these responses a form (Appendix D) requiring either the choice of S, for "same," or D, for "different," was used. If the pattern played was judged the same as the notes flashed on the screen, the subject was to mark the letter "S." If the pattern played was judged to be different from the notes flashed on the screen, the subject was to mark the letter "D." The use of the musical performance of the units called for recognition of the relation of the pattern flashed on the screen to the phrase played on the piano. In those instances when it was desired to present at the piano a musical pattern different from that

flashed on the screen, various changes were made in the direction, spacing, and number of tones.

All the musical units presented in the training program are shown in Appendix B. The musical patterns presented at the piano in a different manner from the corresponding unit flashed on the screen are shown in Appendix C.

The purpose of these lessons was to present the reading materials in such a way as to require a response related to a musical situation. The length and complexity of the musical units increased through the lessons. The difficulty of the music performed also was gradually increased. The intention was to increase the span of recognition visually and necessarily to increase the span of aural comprehension.

Musical units.-- The patterns used in the materials flashed on the screen in the training program were carefully evaluated. The progressive difficulty of the materials was especially checked. As is shown in Chapter IV, there was a gradual increase in the numbers of notes exposed in the patterns and in the range of staff covered. The program of training was designed essentially to emphasize the increased span of recognition. The patterns were uniform in the use of a simple staff only, in the use of half-notes throughout, and in the elimination of clef signs, bar lines, accidentals, and other marks.

Figure 1 shows illustrations of slides used in various training lessons and of the corresponding passages heard by

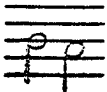
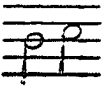
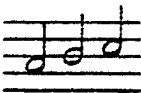
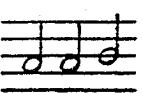
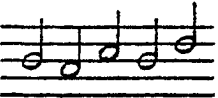
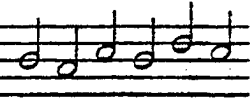
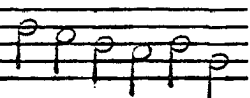
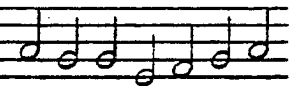
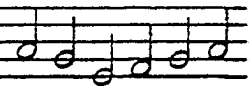
	Notes Flashed on Screen	Notes Played on Piano
Lesson VI		
Slide 7		
Lesson VII		
Slide 22		
Lesson VIII		
Slide 35		
Lesson X		
Slide 39		
Lesson XII		
Slide 33		
Lesson XVIII		
Slide 39		

Figure 1.-- Typical Slides Used in Training Lessons, and Corresponding Piano Passages Differing in Various Ways from the Slides.

the subjects. All of these examples represent items requiring the response of "different," since in these cases the piano performed a passage varying from the notes shown on the screen.

It will be noted that the difference between the passages lies in some cases in the direction of the melody. In other cases the variation consists of the repetition of different notes or in a change in the melody itself. In some passages a different number of notes were played. In all cases the first note of every passage was the same in the piano performance as the note flashed on the screen.

Further explanations can be made from this figure. The count of notes in the excerpts can be clearly understood. Thus, slide 7, from lesson VI, presents two notes, the succeeding examples three, four, five, six, and seven notes in order. The progressive difficulty of the materials flashed on the screen was determined by gradually adding musical excerpts with more and more notes included.

A second factor in difficulty can be seen in the figure. Each excerpt covers a certain range on the staff from the lowest to the highest line or space. This interval, between the lowest and highest note, gives a vertical measurement of difficulty in reading, while the note count gives a horizontal measurement. It may be noted that the vertical notation of music introduces a consideration in reading music not found in language reading.

Tabulation of the interval count of each slide was made. Thus, in the examples given, slide 7, of lesson VI, extends over a range of two lines and spaces and is considered an interval of a second. Slide 22, of lesson VII, extends over a total range of a third; slide 35, of lesson VIII, also covers only three lines and spaces, from the lowest to highest note, even though four notes are included. Similarly, slide 39, of lesson X, covers an interval of a fourth, but includes six notes. Slide 33, of lesson XII, covers a range of a fifth from the lowest to highest notes, and slide 39, of lesson XVIII, covers a range of a fourth in its seven notes.

Use of pre-test.--- Following the first five practice periods it was necessary to introduce the change of response based on the musical performance of units either the same as or similar to those shown on the screen. For the introductory lesson the slides for the final practice period were used.

This was done for two reasons. The presentation of this lesson served to explain the change in method of response. All the pupils had to react by listening as well as watching for the first time in this lesson. This response was used throughout the remaining lessons.

The use of the slides for lesson XX also served as a pre-test when compared with the second reading at the end of the series. It was realized that the first use of the different response would be difficult because of the change

in teaching method. The limitations of the score results were considered. Since some introduction of the plan was needed, the added possibility of the final comparison of the pre-test and lesson XX was planned.

Lesson VI through X.-- The slides used for lessons VI through X were the same slides used for lessons I through V. The musical response replaced the training in which copying and matching were emphasized.

Lessons XI through XX.-- Slides were prepared for each remaining lesson. The same response was continued throughout these lessons. All the musical passages flashed on the screen are shown in Appendix B. The altered forms of passages which were modified in playing are given in Appendix C. The materials for the entire series of lessons are given where any alteration in performance on the piano required a response of "different," on the answer sheet. Excerpts which were flashed on the screen and played without change are not repeated in Appendix C.

No clef sign was used in any material, in order to avoid distracting attention from the notes on the staff. In performance at the piano all passages were played as if they had been written on the treble clef. No shifting from bass clef to treble clef was used, in order to avoid the changing of pitch or any emphasis on this factor.

Criteria for Improvement in Recognition
of the Musical Excerpts

Training Lesson Scores.--- As each series of forty slides was exposed in a training lesson, the scores of the individual pupils were calculated. The marking of these response sheets was expedited by use of matrices showing correct answers. As each lesson was completed, the papers were graded and correct responses tabulated. Since the form of response permitted guessing on the part of the subjects, all scores were corrected statistically by subtracting the number of incorrect responses from the number correct in lessons VI through XX. The scoring range extended from zero to forty.

Pupils were permitted to know their individual scores on each lesson. No attempt was made to compare scores. No incentive of group scoring was used between classes. Pupils were not aware of class averages or variations. All emphasis was placed on individual accomplishment without comparison within groups as far as possible. This was considered necessary so that no variable might be introduced by use of any incentive other than personal achievement individually.

The scores of the 158 subjects on each training lesson were carefully recorded. The mean score and standard deviation of the classes were calculated for each lesson.

Measurement of the difficulty of the forty slides in

each training lesson followed the plan explained in connection with Figure 1. The number of notes shown on each slide was recorded. The maximum interval from the lowest note to the highest note on each slide was recorded. The note count gave a horizontal measure of span of recognition and the maximum interval count gave a vertical measure of the span of recognition. Both measures taken together gave a composite area estimate of difficulty of each slide.

Table 3 presents the note count and maximum interval tabulation of the slides in training lessons I through V. These slides were used again as lessons VI through X, utilizing a different response technique.

In lesson I (VI), the average number of notes per slide was 2.9, and the average maximum interval width per slide was 3.3. By lesson V (X), the number of notes per slide had increased very slightly (from 2.9 to 3.1), and the interval width markedly (from 3.3 to 4.5).

Table 4 presents for the training lessons XI through XV the same data as Table 3 presents for lessons I through V. In lesson XI the average number of notes per slide was 3.5, and the average maximum interval width per slide was 4.9. By lesson XV, the number of notes per slide had increased very markedly (from 3.5 to 4.7), and the interval width slightly (from 4.9 to 5.0). Each training lesson included a larger average number of notes per slide, and a larger average interval width per slide.

TABLE 3

NOTE COUNT AND MAXIMUM STAFF INTERVAL OF EACH SLIDE SHOWN
IN TRAINING LESSONS I THROUGH V AND VI THROUGH X

Slide No.	Lessons									
	I and VI		II and VII		III and VIII		IV and IX		V and X	
	Notes	Int.	Notes	Int.	Notes	Int.	Notes	Int.	Notes	Int.
1	2	1	2	1	2	2	2	2	2	2
2	2	1	2	2	2	2	2	2	2	2
3	2	3	2	3	2	4	2	4	2	4
4	2	3	2	3	2	3	2	4	2	4
5	2	3	2	3	2	3	2	6	2	6
6	2	3	2	5	2	5	2	5	2	5
7	2	2	2	2	2	2	2	6	2	6
8	2	2	2	2	2	2	2	8	2	8
9	2	3	2	3	2	2	2	2	2	3
10	2	3	2	3	2	6	2	6	2	6
11	2	2	2	2	2	2	2	6	2	6
12	2	4	2	4	2	4	2	7	2	7
13	2	4	2	4	2	4	2	5	2	5
14	2	4	2	4	3	6	2	5	2	5
15	2	4	2	4	2	4	2	8	2	8
16	2	5	2	5	2	5	3	4	3	4
17	2	5	2	5	3	5	3	5	3	4
18	3	1	3	1	3	3	3	3	3	3
19	3	1	3	3	3	3	3	3	3	3
20	3	2	3	2	3	2	3	4	3	4
21	3	2	3	2	3	3	3	3	3	3
22	3	3	3	3	3	5	3	5	3	5
23	3	4	3	4	3	4	3	3	3	3
24	3	4	3	4	3	4	3	3	3	3
25	3	3	3	3	3	6	3	6	3	6
26	3	5	3	5	3	5	4	3	4	3
27	3	5	3	5	3	5	4	4	4	4
28	3	6	3	6	3	6	4	4	4	4
29	3	6	3	6	3	6	4	4	4	4
30	4	3	4	3	4	3	4	5	4	5
31	4	2	4	2	4	2	4	4	4	4
32	4	3	4	3	4	3	4	6	4	6
33	4	4	4	4	4	4	4	3	4	3
34	4	3	4	5	4	5	4	5	4	4
35	4	3	4	3	4	3	4	6	4	6
36	4	3	4	3	4	3	5	3	5	3
37	4	4	4	5	4	5	5	4	5	4
38	4	5	4	5	4	5	5	5	5	5
39	5	5	5	5	5	5	5	4	5	4
40	5	4	5	4	5	5	5	5	5	5
Total	116	133	116	141	118	156	125	180	125	179
Mean	2.9	3.3	2.9	3.5	3.0	3.9	3.1	4.5	3.1	4.5

TABLE 4

NOTE COUNT AND MAXIMUM STAFF INTERVAL OF EACH SLIDE SHOWN
IN TRAINING LESSONS XI THROUGH XV

Slide No.	Lessons									
	XI		XII		XIII		XIV		XV	
	Notes	Int.	Notes	Int.	Notes	Int.	Notes	Int.	Notes	Int.
1	3	2	3	2	3	2	3	2	3	2
2	3	3	3	3	3	3	5	5	5	5
3	3	3	3	3	3	3	4	5	4	5
4	2	4	4	5	4	5	4	5	5	3
5	2	6	3	3	3	3	3	3	5	5
6	2	5	2	5	4	4	4	4	4	4
7	2	6	3	4	3	4	3	4	3	6
8	2	8	4	3	4	3	4	3	5	5
9	2	3	2	3	4	5	4	5	4	5
10	4	5	4	5	4	5	6	5	6	5
11	2	6	5	4	5	4	5	4	5	5
12	2	7	4	5	4	5	4	5	5	6
13	2	5	3	3	3	3	3	3	4	6
14	3	6	3	6	3	6	5	6	5	6
15	2	8	4	5	4	5	4	5	6	6
16	3	4	5	4	5	4	5	4	4	4
17	3	4	3	3	3	5	3	5	3	5
18	4	6	4	6	4	6	4	8	4	8
19	3	3	3	3	5	4	5	4	5	4
20	3	4	4	4	4	4	4	4	5	5
21	4	8	4	8	4	8	6	6	6	6
22	4	3	4	3	4	3	5	5	5	5
23	3	3	3	4	3	4	3	4	4	6
24	3	3	4	3	4	3	4	3	6	3
25	5	8	4	8	5	8	4	5	4	5
26	4	3	4	4	4	4	4	4	5	5
27	4	4	5	7	5	7	5	7	4	5
28	4	4	3	4	3	4	3	4	5	5
29	4	4	4	5	4	5	4	5	5	3
30	4	5	4	5	4	5	4	5	4	4
31	4	4	6	4	6	4	6	4	7	5
32	4	6	3	3	3	3	3	3	4	7
33	4	3	6	5	6	5	6	5	5	3
34	4	4	4	4	4	5	4	5	4	5
35	4	6	5	5	5	5	5	5	5	5
36	6	4	6	4	6	4	6	4	6	4
37	5	4	4	3	4	3	4	3	4	4
38	5	5	5	5	6	5	6	5	5	7
39	5	4	4	4	4	4	4	4	6	8
40	6	7	6	7	6	7	5	6	5	6
Total	138	195	157	179	165	184	173	181	189	201
Mean	3.5	4.9	3.9	4.5	4.1	4.6	4.3	4.5	4.7	5.0

Table 5 presents the note count and maximum staff interval of each slide shown in training lessons XVI through XX. In lesson XVI the average number of notes per slide was 4.7. By lesson XX the number of notes per slide had increased markedly (from 4.7 to 5.2), and the interval width slightly (from 5.1 to 5.3).

Tables 3, 4, and 5 show the increase of difficulty designed into the training lessons by increasing the average number of notes per slide and the average maximum interval width per slide. The average number of notes per slide increases from 2.9 in lesson I to 5.2 in lesson XX. The average maximum interval width per slide increases from 3.3 in lesson I to 5.3 in lesson XX.

By relating the mean of the scores achieved by the pupils on each training lesson to the difficulty of the materials presented, as measured by the average number of notes and the average width of interval, a logical basis for criteria measuring improvement in recognition was established.

Item analysis.-- Additional criteria, indicating progress in recognition of the musical units flashed on the screen, were considered. In each series of slides throughout the training lessons, units of certain difficulty were included. Every lesson had at least one four-note slide with a maximum interval count of four. Each lesson also had at least one slide shown which included five notes and covered a maximum staff range of a fifth. Items meeting these specifications

TABLE 5

NOTE COUNT AND MAXIMUM STAFF INTERVAL OF EACH SLIDE
SHOWN IN TRAINING LESSONS XVI THROUGH XX

Slide No.	Lessons									
	XVI		XVII		XVIII		XIX		XX	
	Notes	Int.	Notes	Int.	Notes	Int.	Notes	Int.	Notes	Int.
1	3	2	4	3	4	3	4	3	4	5
2	5	5	5	3	5	3	5	3	5	4
3	4	5	6	8	6	8	6	8	6	5
4	5	3	5	3	7	5	7	5	7	5
5	5	5	5	5	6	4	6	4	6	4
6	5	5	5	5	5	5	5	4	5	4
7	3	6	3	6	4	5	4	5	4	5
8	5	5	5	5	6	4	6	4	6	4
9	5	5	5	4	5	4	3	8	3	8
10	6	6	4	3	4	3	4	3	5	6
11	5	5	5	5	6	7	6	7	6	7
12	5	6	5	6	4	8	4	8	4	8
13	4	6	4	6	6	8	6	8	6	8
14	5	6	3	3	3	3	3	3	3	8
15	6	6	6	6	5	9	5	9	5	9
16	4	4	4	4	5	6	5	6	5	6
17	3	6	3	6	3	6	4	3	4	3
18	4	8	5	4	5	4	5	4	4	5
19	4	6	4	6	4	6	6	4	6	4
20	5	5	5	5	6	5	6	5	6	5
21	6	6	4	4	4	4	4	4	4	3
22	5	5	5	3	5	3	5	3	6	4
23	4	6	4	6	6	3	6	3	6	3
24	6	3	6	4	6	4	6	4	6	3
25	4	5	3	5	3	5	3	5	5	6
26	5	5	5	5	5	4	5	4	5	4
27	4	5	4	5	6	5	6	5	6	5
28	5	5	5	5	5	5	5	5	5	5
29	5	3	5	3	5	7	5	7	5	7
30	4	4	4	4	5	7	5	7	5	7
31	7	5	7	5	6	6	6	6	6	6
32	4	7	4	7	5	5	5	5	5	6
33	5	3	5	3	6	6	6	6	6	6
34	5	4	3	4	3	4	5	3	5	3
35	5	5	5	5	6	8	6	8	6	8
36	6	4	6	8	6	8	6	8	5	3
37	4	4	4	4	4	4	4	4	4	4
38	5	7	5	7	6	5	6	5	6	5
39	6	8	6	8	7	4	7	4	7	4
40	5	6	5	3	5	3	5	4	5	6
Totals	189	205	186	194	203	206	206	204	208	211
Mean	4.7	5.1	4.7	4.8	5.1	5.2	5.2	5.1	5.2	5.3

varied in make-up and location throughout the lessons but were included in all of them.

As an added criterion for measuring the progress in recognition of the slides by the pupils, a count of the correct responses was made for each lesson on the particular items to be compared. The number of correct responses on items of the same difficulty formed additional criteria for establishing improvement in recognition of the musical excerpts flashed on the screen.

It was assumed that, if greater numbers of pupils succeeded in recognizing the materials of a set level of difficulty, then an increase in comprehension span or improvement in utilization of the span of recognition had occurred.

Criteria for improvement in recognition of the music were established by comparing the progress of difficulty in the materials read with the mean score of the group on each lesson. In addition, the number of pupils recognizing items of comparable difficulty throughout the lessons was used as a criterion of attainment.

General Criteria for Measurement of Reading Ability in Music

Reading tests in music.--- In order to establish a basis for measuring the results of the training program, a standardized test of reading achievement in music was necessary. As reported by Mursell, ¹³

¹³ James L. Mursell, The Psychology of Music, p. 251. New York: W. W. Norton & Co., 1937.

Virtually no experimental research has been carried on dealing with psychological processes involved in the comprehension of written music.

Very few standardized achievement tests in reading music were available. Some of the older so-called reading tests in music required recognition of familiar melodies from the musical notation presented. These tests did not measure the reading of music so much as a familiarity with well-known melodies and the notation thereof. The actual comprehension of musical notation involving sight reading was required in a satisfactory test.

Since the measurement of reading ability in music before and after the training program was required in this experiment, a standardized achievement test in reading music was necessary. The test had to include two forms which were reliable and valid. The instrument which best met all these demands was used in the experiment. This was the Achievement Test in Music, by William E. Knuth.

The William E. Knuth, Achievement Test in Music, Division III, Form A, was used in this study to establish original scores in reading music for all the pupils. At the end of the training lessons given to the experimental groups, Division III, Form B of the same test, was given to measure reading achievement of all pupils in this study.

Purpose and Nature of the Knuth Achievement Test in Music.-- According to the Knuth Manual. ¹⁴

¹⁴ William E. Knuth, Achievement Tests in Music. Minneapolis: Educational Test Bureau, 1936. Pp. 75.

This achievement test provides a valid and reliable measure of the pupil's ability to recognize and comprehend music from its notation. The pupil hears a performance of complete musical phrases, and the test measures his recognition and comprehension of the phrases performed...The test provides a means of determining whether a pupil's music reading difficulties are located in the comprehension...An analysis of the pupil's errors on the test will determine his specific difficulties and will suggest to the teacher certain instructional needs.

The testing of recognition and comprehension is accomplished through measuring complete musical phrases rather than the dissected elements of music. No attempt is made to test isolated facts about music, because music is an integrated unit. The test items are, therefore, composed of various melodies containing certain specific idioms which are presented to the pupil through the medium of the piano.

The complete test is composed of three divisions of two equivalent forms each. Division I is constructed for grades III and IV, Division II for grades V and VI, and Division III for grades VII and VIII, Junior high school, and Senior high school. The test items are placed in order of difficulty as revealed by an experimental tryout of 4,208 tests given in five cities of the San Francisco Bay area.

Validity of the test.-- In the construction of this test, three means of establishing validity were used:

First, by a detailed text book analysis of nine well-known public school music series which isolated the various problems of music reading as taught in the public school.

Second, by the pooled judgments of six music supervisors and college teachers of public school music on each of the test items. Each test item was composed to include certain difficulties secured from the text book analysis, yet representing a complete musical phrase.

Third, by an experimental tryout using 4,208 tests which secured the percentage of item successes at each consecutive grade level. These preliminary tests were given to pupils of representative public schools in five cities of the San Francisco Bay area. Fifteen pupils were selected at random from each half grade from grade three up to and including grade eight.

Reliability of the test.-- Considerable care, time and funds were used to establish, experimentally, the reliability of this test.

For the final tryout 6,158 tests were administered in eleven public school systems selected from various sections

of the United States. These schools were chosen from widely different geographical sections representing rural, small, and large city population.

The reliabilities were computed by using the Spearman-Brown formula. The results for Division III were found to be $r_{AB} .340 \pm .0058$.

The test form.-- Each student is supplied with a practice sheet, test booklet, and response sheet. The items consist of complete musical phrases of four measures each, played on the piano by the examiner. The response sheet shows the first two measures of the item exactly as played by the piano. The phrase is completed on the response sheet in four ways, one of which is correct. The response is merely to place a mark beside the measures chosen. Forty phrases are played in each complete test. The booklets are arranged for maximum legibility and easy understanding. A key is furnished permitting objective scoring of results. As noted, two forms, A and B, are available. The test yields scores ranging from zero to forty. Norms are provided for the use of the examiner. Figure 2 shows the actual practice sheet from the test. This illustrates the form of the test. The test booklets follow the same plan in presenting the materials of the actual test.

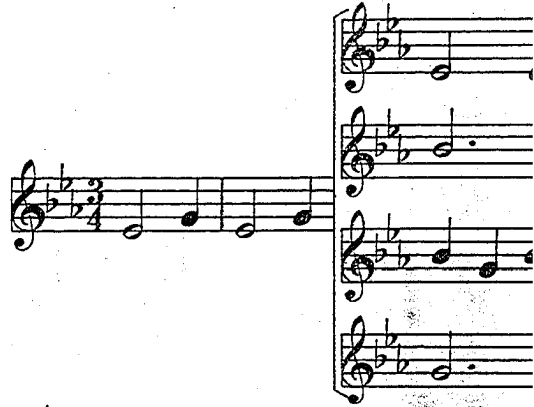
Final testing program.-- When the experimental groups had completed the twenty-sessions in reading the notes flashed on the screen, all the students of both the experimental and control groups were given the Achievement Test in Reading Music, by Knuth, Division III, Form B. As previously described, this test is correlated closely with the

1

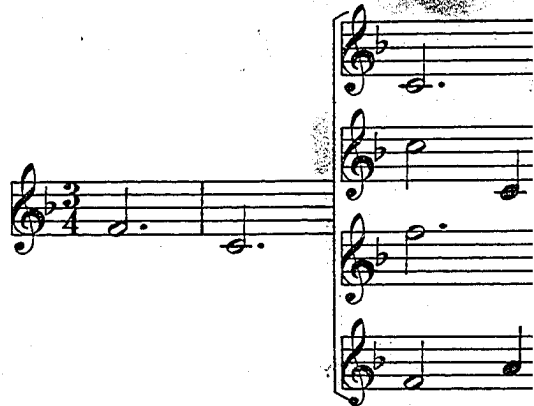
KNUTH
Achievement Tests
in
MUSIC



2



3



4



INSTRUCTIONS

A chord of music will be the signal announcing each new melody. Listen carefully and place a cross in the square after the measures you hear played. If you have any questions while doing this page, be sure to ask them now.

Are you certain how and where to place your crosses?

Figure 2.-- Practice Sheet from the Knuth Achievement Test

original Division III, Form A, used at the opening of the experiment, and is made of the same types of items and constructed in the same way.

The results of this test form the final basis of comparison for the groups. The classes of grades seven and eight received no further testing. The pupils of the instrumental groups, in both the experimental and control sections, were further tested by the method described in later pages.

All data for comparisons of achievement in reading music were finally based on the results of the Knuth Tests, Form A and B. The test scores for the experimental and control groups were used as the criteria for measurement of achievement in reading music.

Criteria for Achievement by the Instrumentalists in Reading Music

Additional data on instrumental players.-- Each player of a musical instrument included in the experimental and control groups was further tested individually on sight reading performance. The method was possible with this group alone. The seventh and eighth-grade pupils included in the experiment were not proficient performers of music individually and could not be checked by the following method.

Index of reading performance.-- By recording individual playing on a phonograph recording machine it was possible to time accurately and to check for correct playing the musical passages involved in the testing. The index of

reading performance was established as the ratio of the sight reading index divided by the technical performance index.

Each performer played an ascending and descending scale of his own choice at as rapid a speed as possible with good tone and control. This requirement was announced two weeks before the time of the recording, so that the student could prepare this technical requirement well. The technical performance index was then established as the average number of tones played per second. All playing was recorded and carefully checked by numerous re-playings in analyzing and determining the time and count of tones played. The technical performance index was established then as the average number of musical tones correctly played per second in a scale passage chosen by the performer.

To provide an index of sight reading ability, each player read at sight as rapidly and correctly as possible a passage arranged for his particular instrument. It was necessary to use a musical selection involving notes of one rhythm value only, so that speed and accuracy would be emphasized. Further, the player was advised to use any articulation, in the case of wind players, and any bowing style, in the case of string players, so that speed was not sacrificed to the demands of correct musical phrasing.

The use of a test passage limited to notes of one value was carefully considered and adopted. The intention

was to find an objective basis of scoring the sight reading of the players for the purpose of this study. Any variation of rhythmic value would have introduced the need for an entirely different, and undoubtedly more subjective, basis of scoring. It will be recalled that in the training materials used in this study all notes were of a single value. For purposes of general testing of sight reading performance a standard including rhythm variation probably would be desirable.

The test passages included were also considered likely to show any transfer of span of recognition development from the training lessons. The intention was so to construct all materials of the individual performance tests as to give every opportunity for the improvement in width of span of recognition to operate to advantage of the skilled player. The development of such an improved skill of reading was considered to be more useful in a passage of unlimited speed of performance. The rapidly moving performer would then be using all advantages of reading skill to improve his playing and would be limited only by this technical skill of performance. The average musical passage never used the limit of reading speed of the performer, or the limit of the recognition span of the eye, because the meter, or takt, of the flow of the melody, determines the reading speed. This tempo is usually a slower rhythm than the ability of the player could execute. The tempo also makes the use of the

full span of visual recognition unnecessary in most passages. Only in faster moving passage-work is the full technique of the player utilized and the span of recognition of the eyes pushed to a maximum use. The test passages offered these opportunities for upper limits of reading skill and technical skill to be displayed.

The sight reading performance was recorded for each instrumental player. This included different types of instruments such as violin, clarinet, trumpet, etc. To adjust the passage for ease of playing range, key signature, and various clefs of different instruments, it was necessary to have transposed arrangements of the selection copied for the various instruments. The passage selected for the determination of the initial sight reading index was the opening 129 notes from Etude Number 2, of Rudolph Kreutzer, Etudes for Violin, a standard publication available from many publishing companies. The arrangement of keys, clefs, and transpositions, is shown in Appendix F.

Key and range for various instruments were carefully determined. It will be noticed that the maximum interval range of the selection is just one octave. The choice of register permitted the brass instruments to play in medium range. The demand upon the technical skill of the performers was not great enough to slow the reading to any considerable degree. The material was intended to allow easy, skillful performance. It will be noticed, therefore,

that cornets, trumpets, French horns, and baritone horn in treble clef read the same score. Violin, flute, oboe, clarinet, and saxophone played from one score. Cello, bassoon, trombone, and baritone horn in bass clef, played from one score. Tubas read from a different score. All of the examples were written out on the musician's model typewriter. Legibility was uniform throughout.

As in the case of the technical performance index, the index of sight reading consisted of the average number of tones correctly played in one second. Recordings again were used to make this determination accurate.

The final index of reading performance was the index obtained by dividing the sight reading index by the technical performance index. This final index measured the player in reading at sight on the basis of ability to play technically.

An example of index of reading performance.-- To illustrate the determination of the various indices, the performance of pupil thirty-four from the experimental group is considered. In the performance of the scales this clarinetist played 29 tones in 4.2 seconds. This gave a technical performance index of 6.91 tones per second. It may be noticed that the number of scale tones played varied with different students. Choice of particular scale and determination of the exact number of tones were left to the student. Ascending and descending scales were suggested, with any phrasing the player cared to use. The suggestion was made to play as accurately and rapidly as possible. Some

players played slightly different scale endings at the upper and lower limits of the scale. This made variations in number of tones played. Of course the number of tones per second would figure the same no matter if twenty-nine or thirty-three notes were played, since extra time would be used for more tones. Accuracy in counting and timing was necessary. Frequent re-playings of the recordings made accurate measurement possible.

Pupil thirty-four now played the test passage as accurately and rapidly as possible. This selection included 129 notes. One note was omitted by the player, so that he performed 128 notes in twenty-two seconds. This, by division, gives the index of sight reading as 5.82 tones per second. It may be noted that this is extremely fast performance. This player was an excellent performer and good sight reader.

For the final index of reading performance the index of sight reading (5.82 times per second) is divided by the index of technical performance (6.91 tones per second) to give the final index of reading performance of .843. The index of reading performance provides a way of comparing the technical performance scale of a player with the use of this skill in actually playing music at sight. All materials used should give the player opportunity for displaying the skill. Comparisons of different instruments require that the arrangement of test materials be made equally easy for the different ranges, clefs, and keys of the various instruments.

Considerable skill attaches to the determination of these equalizing factors in the performance of different instruments.

For the purposes of this study the instrumental players of the control and experimental groups were matched as to particular instrument played. This fact made the final measures of index of reading performance comparable. The index of a clarinetist in the control group and a clarinetist in the experimental group are compared. These same subjects had been previously matched to a very close degree on the basis of the Knuth Test scores considered earlier.

Comparisons by index of reading performance.--

The index of reading performance is thus an original attempt in this study to compare the ability of one player to read at sight with the ability of other players to read the same materials at sight, based on technical proficiency in each individual case. The index demands that the players establish an accurate technical index by performing the scale passage as rapidly as it is possible to play correctly. If a player were to establish a slow technical speed intentionally, the final reading performance index would be higher than a true measure of reading ability.

For this reason the method of computing the index of reading performance was not explained to the players at any time. All were asked to play all materials as rapidly and accurately as possible. All players were given two

weeks for preparation before the individual recordings were made.

The index of reading performance is therefore an attempt to establish a method of comparing sight reading abilities on different musical instruments, a problem recommended previously by the writer for further study.¹⁵ The index is a valid measure, if all conditions before described are controlled. The arrangement of the passages for various instruments involves knowledge of these instruments, so that the performance difficulties are equalized.

In this experiment all instrumental players made recordings of the index of reading performance, one recording before and one recording after the experimental training program. It was possible to compare individual and group progress by this means. The index of reading performance was to give an added measure by which to check the results of the reading training for the instrumental players.

The index of reading performance could be used to compare players of different instruments, such as cornet and violin. This is possible, because the manipulative variations inherent in each different instrument are accounted for in the technical index. For the same reason players at various stages of advancement in technical ability can also

¹⁵ Charles F. Stokes, "Methods of Guidance in Instrumental Music," p. 92. Unpublished master's thesis, Teachers College, University of Cincinnati, 1939.

be compared. The index of reading performance actually measures how nearly a player can approach his technical capacity in performing material at sight.

For the purpose of this study, the emphasis on sight reading of materials involving no rhythm problems is important. Since the purpose is to train for improvement in span of recognition in reading music, it is evident that this ability enters into music in which performance of rhythm problems is not emphasized. Where the note values rhythmically are all alike, the reading involves only the staff location or pitch of the note. The possibility of wide span of recognition is present in this type of passage more than in a musical selection where longer and shorter rhythm values of notes cause the speed to be varied and the reading to be delayed while proper length of time is given to each tone. This factor acts to shorten the width of span of recognition in the reading of music.

Data on other pupils.-- The large number of pupils in the experiment from grades seven and eight (122) were not instrumental performers. Although all of these children were enrolled in the regular vocal music classes of the school, no individual performance test, such as singing at sight, was used. No valid measure of this ability can be made of pupils who have had no special instruction and have rarely if ever performed individually. The need is present for such students to learn to read music in order to perform

intelligently. This study attempts to use a method of increasing the effectiveness of the music reading. With the voice students the only measure of direct music reading used before and after the experiment was the Knuth Achievement Tests in Music.

Final data on instrumental players.-- At the end of the training lessons the instrumental players of the groups, both experimental and control sections, were checked for reading performance. As in the original tests for index of reading performance, a final technical performance index was established. Each performer again played an ascending and descending scale of his own choice at as rapid a speed as possible with good tone and control. All playing was recorded, so that a careful note count and check of time and accuracy could be made. All tests were made in the week immediately following the completion of the series of flashed musical notations for the experimental groups. The technical performance index was again established as the average of the number of tones correctly played per second in the scale passages.

For the final sight reading index each player read the first 129 notes of N. Paganini's, Perpetual Motion.¹⁶ This selection again offered notes of only one rhythm value,

¹⁶ Nicolai Paganini, Perpetual Motion. New York: Carl Fischer Pub. Co., 1906. Pp. 5.

so that speed and accuracy would be emphasized. Again the player was advised to use any articulation or bowing he found convenient. To arrange the passage for ease of playing range, easy key signature, and the various clefs of the different instruments, the selection was transposed into various keys as before and copied for the different instruments. The sight reading index consisted of the average number of tones correctly played in one second. As before, all playing was recorded, accurately counted, and timed.

Index of reading performance.-- By the use of the technical performance index and the sight reading index, the index of reading performance was again established as the ratio of these indices. The index of reading performance was the index of technical performance over the sight reading index. The data were compiled for all instrumental players in the experimental and control groups, and are summarized in Chapter V. The initial index of reading performance compared with the final index of reading performance, for both the experimental and control groups of players, provided evidence on achievement in reading music. Statistical analysis was based on these indices.

Summary

This chapter has presented the procedure in this experiment. The design followed the equivalent-groups method. The variable factor in the training of the experimental groups

was the short exposure of musical units flashed on the screen. The experiment was carried on in one school with sixteen groups of subjects receiving training, and sixteen parallel groups not receiving the special training. The pupils were selected from vocal music classes of grades seven and eight and from the school orchestra and band. Subjects were matched on the basis of scores on the Knuth Achievement Tests in Music, and assigned to experimental or control groups by random selection. The experimental and control groups each comprised 158 pupils. Thirty-six pairs of instrumental players were included in this number.

The equipment consisted of a lantern slide projector with a flashmeter controlling the exposure, and screen, and lantern slides prepared by aid of a typewriter with musical symbols. Each slide included from two to seven notes extending over a staff interval range of a unison to a ninth. In general, the response by the subjects called for reading of the musical unit flashed on the screen.

Forty slides were used for each of the twenty lessons. The first five lessons required the instrumental pupils to copy the exposed materials while the remaining subjects matched the unit shown with a multiple-response form prepared for each lesson. For all later lessons all subjects responded by comparing the musical unit shown on the screen with the same or a similar passage played by the experimenter on the piano. Following the first five lessons and preceding the

last fifteen, a pre-test was given, consisting of the slides later presented as lesson XX. This pre-test gave a basis for comparison of initial achievement with final achievement, for the fifteen lessons in which the response required was a combination of visual and auditory discrimination. It also served to introduce the subjects to this mode of response.

Improvement in recognition of the flashed materials was analyzed in various ways. The mean score of the pupils for each training lesson was considered in relation to the difficulty of the materials used, as measured by the mean number of notes per slide and the mean staff interval for each slide. The pre-test and final lesson data were compared. Average performance at successive lessons on certain slides was analyzed, the slides selected being substantially equal in difficulty.

General reading ability in music was measured at the beginning and end of the experiment by equivalent forms of the Knuth tests. Statistical comparisons of the test scores for the experimental and control groups were made, both by the small sample technique and an analysis of the mean difference in scores of the groups. The instrumental players in the groups were tested further by an initial and final measure of sight reading while playing. The criterion for achievement in sight reading was the original measure introduced for this study, the index of sight reading performance.

CHAPTER IV

IMPROVEMENT IN RECOGNITION OF MUSICAL UNITS

Introduction

This chapter presents the data showing improvement in recognition of the musical units during the training lessons. It comprises four sections.

The first section states the plan of the training lessons. The first five lessons are shown to vary from the remaining lessons in type of response required of the subjects.

The second section presents the achievement in recognition of the musical units. The mean scores of subjects on the lessons are compared with the difficulty of the training materials.

The third section shows the improvement in recognition by comparison of scores on particular lessons.

The last section uses scores on certain items of comparable difficulty to demonstrate improvement in recognition of the musical units.

Plan of the Training Lessons

Procedure in training lessons I through V.-- The object of the first five training lessons for the experimental group of subjects was to introduce the reading method. As explained before, in the chapter on procedure, each lesson consisted of the exposure, for one-tenth of a second each,

of the forty slides especially prepared for the purpose. For these early lessons the response by the pupils was as follows. The thirty-six instrumental players were given a prepared form, shown in Appendix D, on which the pupils were asked to write down the exact notes exposed briefly on the screen. It was expected that these subjects would be able to respond in copying the notation because of their familiarity with the notation of music. These responses were scored and tabulated.

The 122 pupils who were not skilled musicians were shown the same slides in these lessons. The response to the exposure was different from the copying of notation required of the instrumental players. A prepared form was made for each lesson. These forms consisted of four units of musical groups arranged as multiple choice response items for each slide exposed. The forms are shown in Appendix E, for the series of five lessons. The response sheet used by the pupils is included in Appendix D. As each slide was exposed the pupil selected the particular response unit, among the four given, which matched the musical excerpt shown on the screen.

The purpose of these initial lessons, for the group of pupils relatively unskilled in music, was to bring them to a realization of the multiple forms of music notation and to point out by inspection the varied ways in which music is written on the staff. In the first lesson preliminary explanations were given after the forms had been distributed. By pre-arranged examples the mechanics were shown. After

the class understood the response system, the slides were exposed in order. The number of each slide was announced, and then the words, "Ready, now!" were spoken by the experimenter. The pupils were advised to look over the multiple response items previous to the exposure, so that the selection might be easier to make.

In this phase of the work (the first five lessons) the intent was mainly to orient the subjects to the type of visual symbols presented in the slides. The response called for was purely one of visual discrimination and recognition, with no auditory imagery or auditory response required. While undoubtedly the subjects gained during these lessons in power to recognize the symbols thrown on the screen, they were not required at this time to relate them to music as an auditory experience. These lessons may best be described as having the purpose of orientation, and as providing practice in simple visual recognition, preliminary to training in a more complex and more musical type of recognition.

The training lessons in the main part of this experiment (lessons VI to XX) were based upon the assumption that reading music should involve the power to interpret musical symbols in auditory terms, not merely visual. In these lessons the subjects were required to recognize a set of musical symbols as meaning a certain sequence of tones, and then to decide whether the tones which they heard immediately after seeing the symbols were or were not those

that had been presented on the screen. This is a more complicated response than that called for in the preliminary lessons, and one that involves a genuine musical understanding of what is seen. The problem of the fifteen final training lessons was, then, to develop span of recognition in a situation requiring a significant musical response.

Table 6 presents a summary of scoring by the 158 pupils on the first five lessons. The range is from zero to forty, forty slides being used throughout for each lesson. The instrumental players were scored according to the number of slides copied correctly. The remaining pupils were scored on the basis of the correct matching of the multiple response items. The number of correct responses was lowered by one-third the number wrong, so as to allow for guessing, according to the usual statistical procedure.

For the five lessons, the mean scores are as follows, in the order of the lessons: 10.58, 10.73, 11.37, 11.24, and 13.65. The corresponding standard deviations are 8.45, 8.08, 9.94, 9.68, and 9.57. It is interesting to compare the gradual increase in mean through lessons I to V with the difficulty of the materials shown. Table 3, in Chapter III, analyzes the difficulty of the slides. It may be seen that the mean number of notes per slide increased from 2.9 in the first lesson to 3.1 in lesson V. Also, the extent of staff interval covered, giving a vertical measure of span involved, increased from a mean average per slide

TABLE 6

DISTRIBUTION OF SCORES ON TRAINING LESSONS I THROUGH V
FOR 158 PUPILS IN THE EXPERIMENTAL GROUPS

Scores	Frequencies				
	Lesson I	Lesson II	Lesson III	Lesson IV	Lesson V
38-40	1	1	2	3	4
35-37	2	2	4	2	3
32-34	1	2	2	1	4
29-31	0	2	4	6	3
26-28	5	2	8	2	2
23-25	3	4	5	9	12
20-22	12	9	11	6	9
17-19	11	8	6	11	17
14-16	17	12	13	14	17
11-13	22	30	22	17	18
8-10	22	23	16	22	21
5-7	16	29	22	22	23
2-4	19	18	19	12	12
0-1	27	16	24	31	13
Total	158	158	158	158	158
Mean	10.58	10.73	11.87	11.24	13.65
S. D.	8.45	8.08	9.94	9.68	9.57

of 3.3 in lesson I to 4.5 in lesson V. These measures were previously explained and evaluated.

The apparent improvement of the pupils is undoubtedly less than their actual improvement, in view of the fact that their scores increased simultaneously with an increase in the complexity of the materials presented. The pupils were able to respond in a mechanical way to the notation flashed on the screen. The situation did not as yet require a completely musical response, but within its limits the pupils gave evidence of gaining in ability to recognize the outlines and variations in the visual symbols presented.

Achievement in Recognition of Musical Excerpts

Procedure in training lessons VI through XX.-- For the remainder of the training lessons a reading situation was introduced which included the actual use of a musical response. The response sheet, used for all pupils and for all lessons following lesson V, is shown in Appendix D. The notes exposed on the screen and the passages played by the piano may be seen in Appendices B and C. All notes were played with equal volume of tone. The metronomic tempo of ninety per quarter note, or forty-five half notes per minute, was used throughout.

The lessons now involved a reading response based on actual performance of the music. The learning situation was one in which the actual musical notation was related to

music actually heard. This was a method of instruction that could be used with groups in which individual response was to be required. No practical way could be established for having the pupils respond by individual performance of the phrases. While the instrumental players could have been required to perform what music was exposed, this procedure would have resulted in an individual teaching situation. In any group presentation this would not have been possible. By the presentation used it was possible to keep all responses entirely individual, to use groups in instruction, since no individual's performance interfered with the rest of the class, and to present the material in a musical situation that permitted the pupils most limited musically to exercise judgment in comparing the notes presented on the screen with the notes performed at the piano.

Achievement in recognition in lessons VI to X.--

Table 7 presents the distributions of scores for lessons VI through X. It will be recalled that the slides used for exposing the excerpts on the screen were repeated from the earlier lessons I to V with a different method of response required. In these lessons, scores again were corrected for guessing by using the number of correct responses minus the number incorrect.

In lesson VI, during which the slides from lesson I were repeated, the mean score reached 22.6. The standard deviation was 10.0 for this lesson.

TABLE 7

DISTRIBUTION OF SCORES ON TRAINING LESSONS VI THROUGH X
FOR 158 PUPILS IN THE EXPERIMENTAL GROUPS

Scores	Frequencies				
	Lesson VI	Lesson VII	Lesson VIII	Lesson IX	Lesson X
38-40	11	7	2		
35-37	7	5	3		2
32-34	21	12	10	3	10
29-31	10	14	13	5	7
26-28	22	25	22	14	15
23-25	11	16	13	15	6
20-22	18	23	23	22	25
17-19	11	10	15	20	13
14-16	14	14	25	28	23
11-13	9	11	9	12	12
8-10	11	9	12	18	23
5-7	8	4	3	11	4
2-4	3	4	3	7	10
0-1	2	4	5	3	8
Total	158	158	158	158	158
Mean	22.6	21.8	20.6	16.6	16.9
S. D.	10.0	9.4	8.7	7.6	9.2

By the tenth lesson the mean score had dropped to 16.9 with a standard deviation of 9.2. This change of scores must be related to the difficulty of the materials exposed. As in the case of lessons I to V, reference must be made to Table 3. In lessons VI to X, the mean score for recognition dropped as the materials used became increasingly complex.

Achievement in recognition in lessons XI to XV.--

Table 3 presents the distributions of scores for lessons XI through XV. The slides used for these lessons were shown for the first time. The means for these lessons were, in order: 16.2, 15.2, 15.2, 15.4, and 13.9. The corresponding standard deviations were 8.4, 10.4, 9.4, and 2.8.

The mean scores again must be compared with the difficulty of the materials exposed on the screen. Table 4 presents the note count and interval tabulation. The average number of notes per slide in lesson XI was 3.5. This number increased to 4.7 by lesson XV. In addition, the average interval range per slide was 4.9 in lesson XI and changed through various scores to 5.0 in lesson XV. Again the mean score lowered as the difficulty of materials increased.

As already shown, the emphasis during the training lessons was upon development of span of recognition. The materials were designed with increasingly longer units exposed on the screen and with wider staff intervals utilized by the music. The complexity of the passages performed at the piano was also necessarily greater. No objective

TABLE 8

DISTRIBUTION OF SCORES ON TRAINING LESSONS XI THROUGH XV
FOR 158 PUPILS IN THE EXPERIMENTAL GROUPS

Scores	Frequencies				
	Lesson XI	Lesson XII	Lesson XIII	Lesson XIV	Lesson XV
38-40	1	1	1		
35-37	0	2	1	1	1
32-34	5	8	2	4	2
29-31	4	10	8	6	2
26-28	15	11	10	12	6
23-25	11	10	10	13	10
20-22	20	17	26	22	14
17-19	20	12	18	11	15
14-16	25	14	17	13	24
11-13	13	16	7	12	19
8-10	20	13	19	21	22
5-7	8	7	12	13	12
2-4	10	17	7	17	15
0-1	6	20	20	13	16
Total	158	158	158	158	158
Mean	16.2	15.2	15.2	15.4	13.9
S. D.	8.4	10.4	9.4	9.4	8.8

method could be established of rating the difficulty of the piano passages that were modifications of the music presented on the screen.

It may be that the fall in mean score was not so great as might be expected from the increase in difficulty of materials. The mean score of 13.9 in lesson XV was the lowest for the entire training series.

Achievement in recognition in lessons XVI through XX.--

Table 9 presents the distribution of scores for lessons XVI through XX. The mean scores for these lessons were, in order: 14.0, 16.4, 16.2, 15.3, and 15.8. The corresponding standard deviations were 2.9, 9.1, 10.4, 9.6, and 10.4.

Comparison of the scores with the difficulty of materials is again necessary. It will be noted in Table 5 that the average number of notes per slide for lessons XVI through XX begins with 4.7 and increases to 5.2. The difficulty as measured by the average interval range per slide moves from 5.1 to 5.3 in the same lessons. The slight increase in mean scores through these lessons is more noteworthy than it may seem, since the training materials were at the same time becoming increasingly more difficult.

Achievement in Recognition Compared With Difficulty
of Training Materials

Tabulation of difficulty of materials.-- Figure 3 presents graphically the general increase in difficulty of the musical phrases shown on the slides for the successive

TABLE 9

DISTRIBUTION OF SCORES ON TRAINING LESSONS XVI THROUGH XX
FOR 158 PUPILS IN THE EXPERIMENTAL GROUPS

Scores	Frequencies				
	Lesson XVI	Lesson XVII	Lesson XVIII	Lesson IX	Lesson XX
38-40		1	2	3	2
35-37	2	2	5	3	5
32-34	2	5	6	4	6
29-31	4	8	10	5	6
26-28	8	13	13	11	10
23-25	8	14	11	8	13
20-22	25	18	15	17	13
17-19	18	13	10	17	15
14-16	16	20	15	20	23
11-13	15	16	15	15	12
8-10	17	18	18	16	16
5-7	12	10	16	15	11
2-4	15	12	12	14	14
0-1	16	8	10	10	12
Total	158	158	158	158	158
Mean	14.0	16.4	16.2	15.3	15.3
S. D.	8.9	9.1	10.4	9.6	10.4

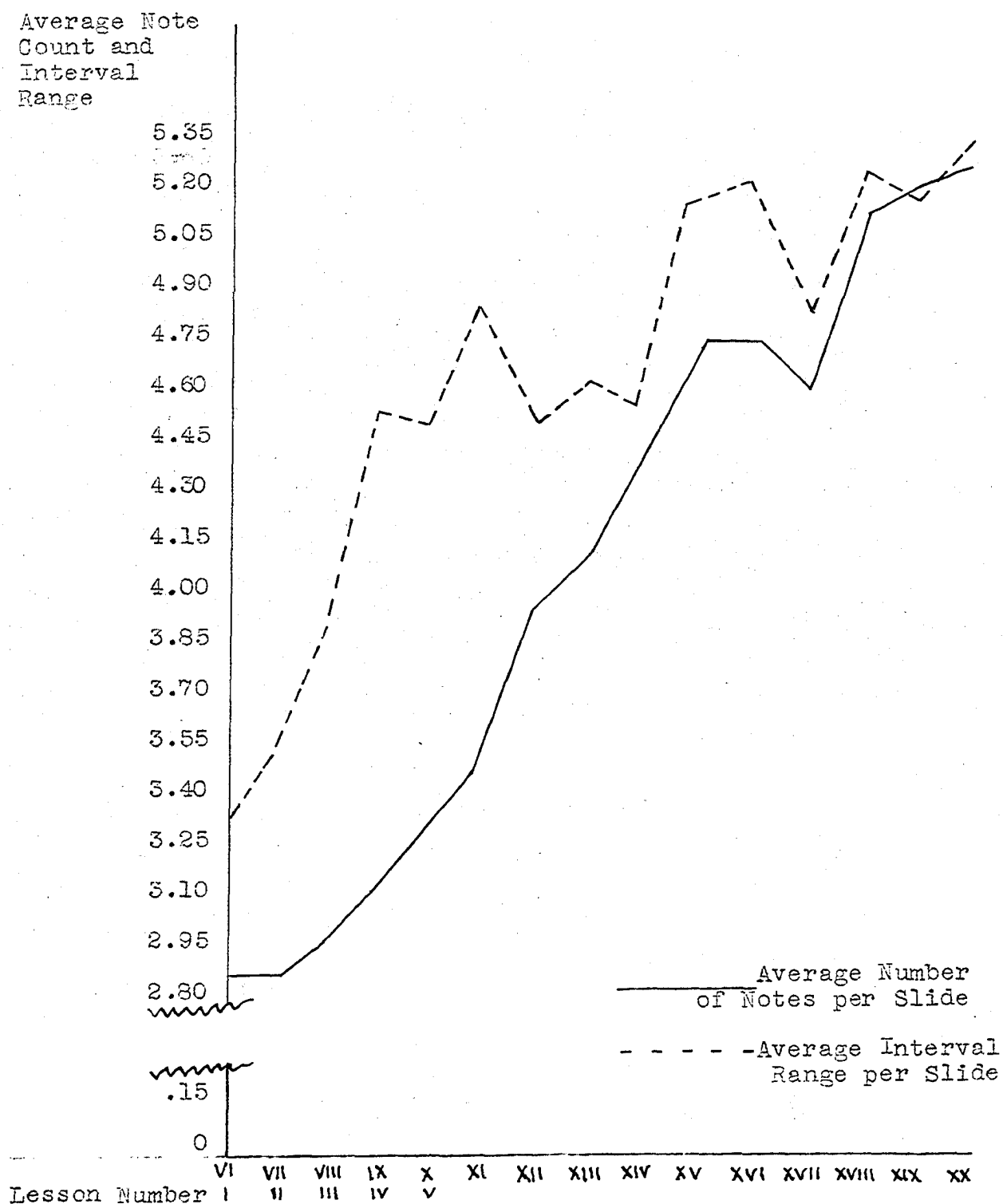


Figure 3.-- Average Note Count and Average Interval Range for the Slides in Each Training Lesson.

lessons. The solid line shows an increase in average number of notes per slide from 2.9 in lesson I to 5.3 in lesson XX. The broken line shows an increase in average interval range per slide from 3.3 in lesson I to 5.3 in lesson XX. This figure utilizes the data presented previously in Tables 3, 4, and 5.

Mean and standard deviation of scores in training lessons VI through XX.--- Figure 4 presents data on the mean score and standard deviation for each lesson from VI through XX. The mean score for achievement in recognition of the musical patterns gradually was lowered in lessons VI to lesson XV. A slight gain may be found in the final lessons.

The variability in scores, in terms of standard deviation, is shown by the dotted line. A decrease in standard deviation occurred in the first four lessons, when the mean score also dropped sharply, but the variability was relatively constant in the remaining lessons.

Data are not given for lessons I to V, because these have been previously reviewed. Due to the method of presentation these data would not be comparable with those for lessons VI to XX.

Mean scores compared with mean difficulty of materials.--- Figure 5 combines data from Figure 3 on difficulty of materials presented with data from Figure 4 on achievement, in lessons VI-XX. The solid line shows the mean score of the pupils for each lesson. The dotted line shows the mean number of notes

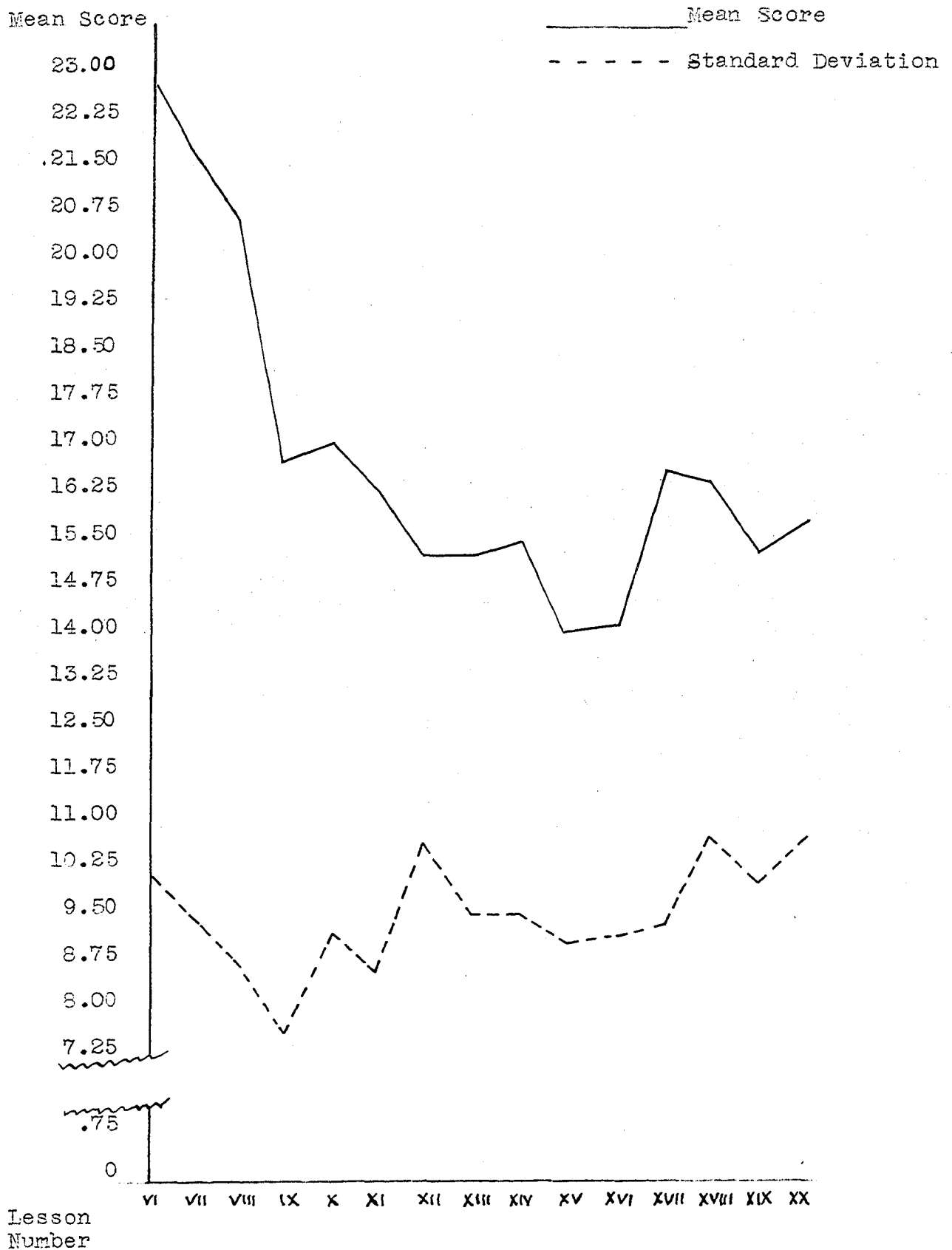


Figure 4.-- Mean and Standard Deviation of Scores in Training Lessons VI Through XX for 158 Pupils in Experimental Groups.

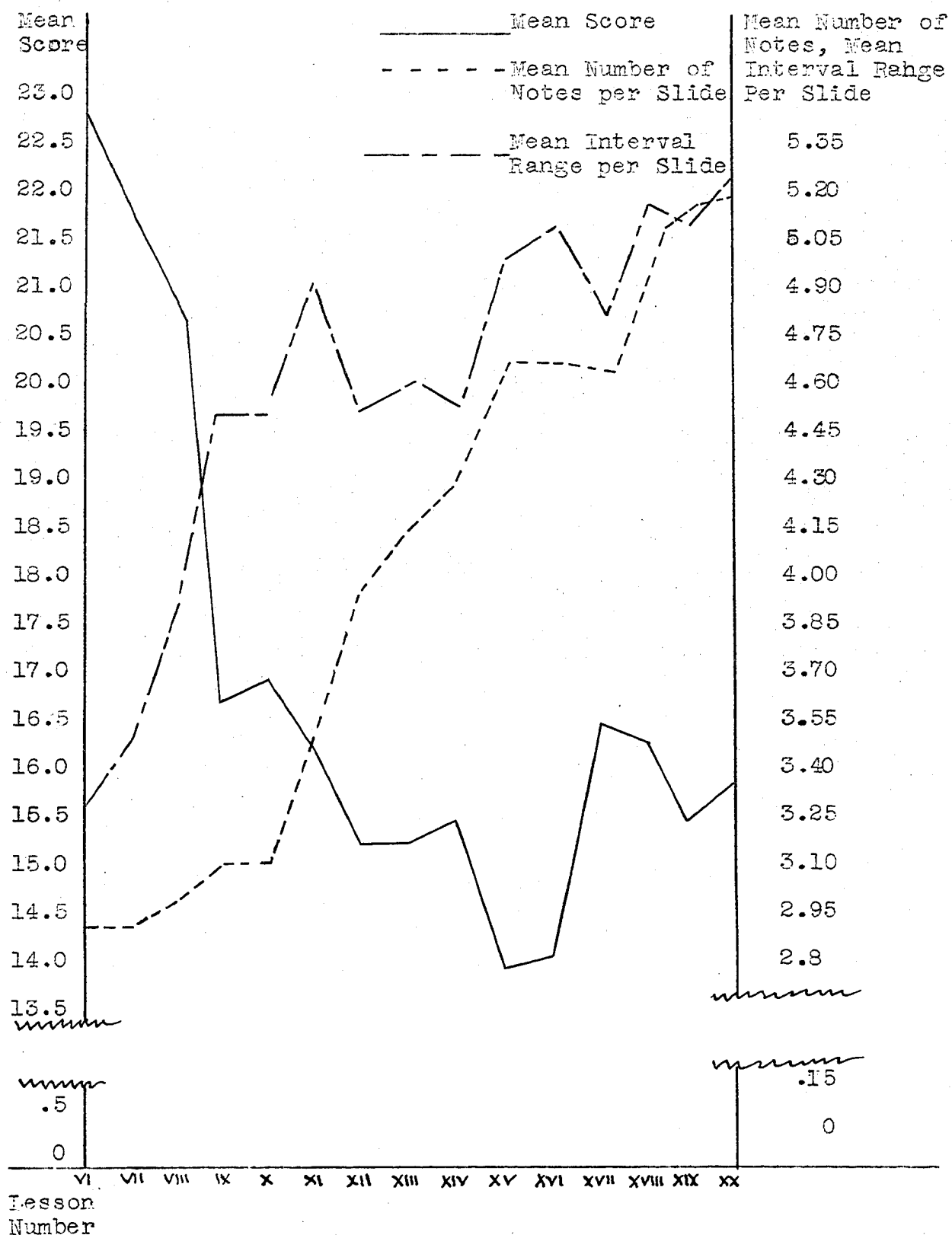


Figure 5.-- Mean Scores of Subjects Compared with Mean Numbers of Notes Exposed and Mean Size of Maximum Intervals on Slides Shown in Training Lessons VI through XX.

exposed in each lesson. The broken line represents the mean interval range for each lesson.

The general picture for lessons VI through XV is one of materials increasing in complexity, while the scores, i.e., the number of correct responses, are lowered.

From lesson XVI to the final lesson a slightly different relationship can be noted. It seems likely that the rise in mean score may indicate a significant development in power to recognize the musical units. As the materials continued to grow more difficult, there was, nevertheless, a tendency for the accomplishment score to rise.

Evidence of Improvement from Pre-test to Final Lesson

Data gathered by pre-test.-- As has been mentioned earlier, the slides from lesson XX were presented as a pre-test between lessons V and VI. It will be recalled that following lesson V the manner of presentation of the slides was changed to include the musical performance of the excerpts at the piano. The pre-test served partly as an introduction to this new method and also to give a basis for comparison with final achievement.

The pre-test consisted of a lesson given in the same manner as the lessons which followed. The pupils were, however, using the new technique for the first time. The slides were the most difficult to be used at any lesson. The results of the scores on this lesson must be judged in the light of this presentation.

Comparison of pre-test scores and scores on

Lesson XX.-- Table 10 presents a comparison of the scores on this pre-test lesson with scores on the same material when presented again later as lesson XX. As might be expected, the scores for lesson XX are markedly higher than those for the pre-test. The mean for lesson XX is 15.8; that for the pre-test 9.2. It must be noted that the effect of the change of presentation of material is evident in the scores. This pre-test served to introduce the reading of the music with the response patterned from the passage sounded on the piano. Since the judgment of the performed musical pattern was a new element in the lesson, the scores would reflect this. Also, the scores must be affected by the difficulty of the materials exposed for reading. The average number of notes per slide of 5.2 for this series is appreciably higher than the average of 3.1 in the lesson preceding. The average interval range per slide (5.3) is also higher than the lesson preceding, which measured 4.5. The difference in mean score of 9.2 on the pre-test compared with 15.8 for the same slides presented as lesson XX gives some measure of improvement in recognition of the musical materials. This gain may be partially caused by the unfamiliarity of procedure in the first showing. However, it seems likely that some significant portion of this improvement occurred as a result of the reading lessons.

TABLE 10

DISTRIBUTION OF SCORES FOR 158 PUPILS ON THE SLIDES OF TRAINING LESSON XX WHEN USED AS PRE-TEST PRECEDING LESSON VI AND REPEATED LATER AS LESSON XX

Scores	Frequencies	
	Pre-test	Lesson XX
38-40		2
35-37		5
32-34		6
29-31	1	6
26-28	2	10
23-25	5	13
20-22	8	13
17-19	10	15
14-16	26	23
11-13	8	12
8-10	26	16
5-7	18	11
2-4	24	14
0-1	30	12
Total	158	158
Mean	9.2	15.8
S. D.	7.4	10.4

Improvement in Recognition of Certain Items
of Comparable Difficulty

Analysis of responses to certain items.--- In order to establish further whether improvement in recognition of the musical excerpts had been achieved, analysis of certain items in the training lessons was made. The intent was to select series of items, one from each lesson, of substantially equal difficulty, and to determine whether in such series of items the number of pupils giving correct answers increased from lesson to lesson.

Table 11 presents the data for the pre-test and lessons VI-XX on items which include four notes and an interval range of a fourth, and on items which include five notes with an interval range of a fifth. One item of each kind from each lesson was selected. In general, items from the latter portion of each lesson were used.

For both series, Table 11 gives evidence of gradual improvement from the pre-test through lesson XX. The four-note item in the pre-test received a correct response from sixty out of 158 pupils. The corresponding item in lesson XX was responded to correctly by 121 pupils. For the five-note items, the number of correct responses increased from fifty-five in the pre-test to 106 in lesson XX. Improvement was gradual, though irregular, during the intervening lessons.

Analysis of items with six and seven notes was also made. Ten lessons, in all, contained musical excerpts

TABLE 11.

NUMBER OF CORRECT RESPONSES TO CERTAIN FOUR- AND FIVE-NOTE ITEMS
IN THE TRAINING LESSONS

Lesson Number	Identifying Number of Items with Four Notes and Interval Range of a Fourth	Correct Responses from 158 Pupils	Identifying Numbers of Items with Five Notes and Interval Range of a Fifth	Correct Responses From 158 Pupils
Pre-test	37	60	28	55
6	37	76	39	68
7	33	80	39	73
8	33	91	40	86
9	31	98	40	69
10	34	86	40	59
11	34	89	38	65
12	39	95	35	88
13	39	105	35	87
14	39	97	35	80
15	37	89	35	97
16	37	99	35	87
17	37	120	35	90
18	37	94	32	92
19	37	101	28	100
20	37	121	28	106

of six notes with an interval range of a fourth. Only six lessons presented items with seven notes and an interval range of a fifth. The pre-test, repeated as lesson XX, gives an added item in each case.

Table 12 presents data on these items. In the pre-test fifty-eight pupils responded correctly to the six-note item. By the final lesson 106 pupils were able to identify the corresponding item correctly. Fifty-one pupils identified the seven-note item in the pre-test correctly. In the final lesson one hundred pupils responded correctly to the comparable item. The table shows gradual but irregular improvement through the intervening lessons.

In this investigation, recognition is assumed to mean the power to connect a visual pattern of musical notes with an auditory pattern, and to say whether or not the two are identical. It may be argued that gains in this power may come from improved grasp of the auditory stimulus as well as from increased visual span. This possibility is recognized, but in the present study, the interest is in gain in the total situation, with a thoroughly musical response required, rather than in visual recognition isolated from musical interpretation and significance.

It is also recognized that items with the same number of notes and the same interval range are not necessarily equal in difficulty. However, the differences in difficulty between such items are probably slight, and any

TABLE 12

NUMBER OF CORRECT RESPONSES TO CERTAIN SIX- AND SEVEN-NOTE ITEMS
IN THE TRAINING LESSONS

Lesson Number	Identifying Number of Items with Six Notes and Interval Range of a Fourth	Correct Responses from 158 Pupils	Identifying Numbers of Items with Seven Notes and Interval Range of a Fifth	Correct Responses From 153 Pupils
Pre-test	19	58	4	51
11	36	62		
12	36	79		
13	36	89		
14	36	66		
15	36	59	31	50
16	36	79	31	91
17	24	104	31	85
18	24	90	4	93
19	24	88	4	92
20	19	106	4	100

errors introduced by such differences in the items of a series such as in Tables 11 and 12 would be compensating rather than cumulative.

Summary

This chapter has shown the immediate results of the training lessons given. The first five lessons were given as introductory lessons involving a matching and copying of the musical excerpts flashed on the screen. The results showed a slight improvement in mean scores. The remaining fifteen lessons required judgment as to the identity or lack of identity of the visually presented excerpts with a subsequent piano performance. The mean scores for lessons VI-XY tended to decrease as the difficulty of the materials increased. For the final group of five lessons an increase in mean was noticed while the materials used were still developing in difficulty. It was concluded that some improvement in recognition of the materials occurred. Added evidence of improvement was obtained by the use of a pre-test, following the five introductory lessons, and later repeated as lesson XX. Considerable improvement occurred from the pre-test to the final lesson. Examination of particular items from the lessons provided further data. The four-, five-, six-, and seven-note items from the various lessons tend, on the whole, to give convincing evidence of improvement on the part of the pupils in

recognizing the musical excerpts flashed on the screen and comparing them with the auditory stimuli provided by the playing of piano passages.

CHAPTER V

EFFECTS OF TRAINING UPON ACHIEVEMENT IN READING MUSIC

Introduction

This chapter presents the effects of the training lessons upon achievement in reading music. The initial and final results in reading achievement for the experimental and control groups are compared. The data are evaluated statistically by means of the small sample technique. Improvement in reading achievement by the experimental group is measured. Improvement in reading achievement by the control group is also measured and finally compared with the accomplishment of the experimental group.

The data are given further treatment in terms of the reliability of the difference between the means of the scores for the experimental and control subjects.

Finally, data relative to the reading performance of the instrumental players are presented. The initial and final measures of sight-reading, for these subjects in the experimental and control groups, are compared statistically.

Reading Achievement Results Analyzed in Terms of Small Sample Technique

Criteria for general achievement in reading music.--

The effectiveness of the experimental lessons in producing gains in general achievement in reading music was determined by the results of the Knuth tests. It was assumed that the

instruction was effective only if the mean change in reading achievement on the part of the experimental groups was greater than that of the control groups by a statistically significant amount. Answers were sought to these questions:

(1) Was the change in reading achievement in music on the part of the experimental groups statistically significant?

(2) Was the change in reading achievement in music on the part of the control groups statistically significant?

(3) Was the difference between the experimental and control groups in reading achievement in music statistically significant, and which groups did it favor?

Statistical techniques used to determine the reliability of differences.-- The design of the experiment was arranged so that it was possible to use the "small sample" techniques developed by P. A. Fisher.¹ The sixteen pairs of classes in this experiment collectively constituted a small sample. Each pair of classes was arranged to comprise pairs of pupils matched on the basis of the original reading achievement scores. Each matched pair of pupils was split at random, one member of each pair being assigned to an experimental class and the other to the corresponding

¹ Ronald A. Fisher, Statistical Methods for Research Workers, pp. 132-133. London: Oliver and Boyd, 1936.

control class. It is possible to consider the sixteen experimental and sixteen control classes as thirty-two cases. The experimental groups (or group, considered now collectively) then consisted of sixteen cases and the control groups (or group) likewise included sixteen cases.

Since the experimental and control groups are each considered as consisting of sixteen cases, the pupils in each class are considered collectively as a single unit. In each case the mean score of the pupils in a class is used to describe the performance of the pupils in that class.

The statistical procedure may be described briefly as follows:²

(1) The mean initial and final scores were determined for each class in both the experimental and control groups.

(2) The means of these means were then found; that is, the initial class means for the experimental group were averaged, the final class means for the experimental group were averaged, and the corresponding averages were found for the control group.

(3) The means of the changes in score from initial to final testing were determined, for each class separately

² The procedure and the description follow rather closely that in recent research of Wayland W. Osborn, "An Experiment in Teaching Resistance to Propaganda," Journal of Experimental Education, 3 (September, 1939), 1-17.

and for each group of classes. The final figures resulting from this procedure were the mean changes from initial to final testing for the experimental and control groups respectively.

(4) The significance of the mean changes in score was determined, by the method suggested by Fisher,³ for the experimental and control groups respectively.

(5) The means of the differences between the changes from initial to final testing were determined, for each pair of classes separately and for the experimental and control groups considered as a pair.

(6) The significance of the mean difference in change between the experimental and control groups was determined, also by the method suggested by Fisher.⁴

The test of significance, used to determine whether the mean differences were greater than those which could be attributed to chance, was "Student's" t-test.⁵ The "t" is the ratio resulting from dividing the difference by which the mean of a small sample differs from any given value by its estimated standard error.

³ Ronald A. Fisher, op. cit., pp. 132-3.

⁴ Ronald A. Fisher, op. cit., p. 166.

⁵ Ronald A. Fisher, op. cit., p. 166.

Since, for small samples, "t" is not distributed in the form of a normal curve, but is distributed in various ways, dependent upon the size of the sample, the meaning of "t" differs for samples of various sizes.

Lindquist ⁶ shows in a table for each number of degrees of freedom from one to thirty what absolute value of "t" would be exceeded in various percentages of all such samples. The size of the sample determines the degrees of freedom.

All calculations have been based upon unweighted means. This procedure was possible, since the matched classes of experimental and control groups were of the same size.

Comparison of mean change for experimental and control groups.-- Table 13 shows the mean initial and final reading achievement scores in music, and the mean change in scores for both the experimental and control groups. It also shows the mean difference in change of reading achievement scores in music between the experimental and control groups.

The mean initial and final scores for the experimental group were 11.74 and 13.21, respectively. The mean gain in the reading achievement score in music was thus 1.47. The t-value of 2.01 for this difference exceeds the value (1.753) required for the ten per cent level of confidence for fifteen degrees of freedom. The five per cent level of confidence requires a t-value of 2.131. The obtained difference (2.01) lies between the ten per cent and five per cent

⁶ E. F. Lindquist, Statistical Analysis in Educational Research, p. 53. Boston: Houghton, Mifflin Co., 1940.

TABLE 13

MEAN INITIAL READING SCORES, MEAN FINAL READING SCORES, MEAN CHANGES
FOR EXPERIMENTAL AND CONTROL GROUPS, AND DIFFERENCES IN MEAN CHANGES
FOR EXPERIMENTAL AND CONTROL GROUPS

Pair of Classes	Experimental Group				Control Group				Differences: Experimental Mean Change Minus Control Mean Change
	N	Mean Initial Scores	Mean Final Scores	Mean Change	N	Mean Initial Scores	Mean Final Scores	Mean Change	
1	10	9.30	8.40	-.90	10	9.50	8.80	-.70	-.20
2	11	3.36	4.64	1.28	11	3.18	6.45	3.27	-1.99
3	12	7.42	10.22	2.91	12	7.67	10.17	2.50	.41
4	11	5.09	4.18	-.91	11	4.36	4.18	-.18	-.73
5	13	3.77	5.54	1.77	13	3.77	5.00	1.23	.54
6	12	14.75	17.50	2.75	12	14.67	19.50	4.83	-2.08
7	14	13.14	20.74	7.60	14	12.43	13.79	1.36	6.24
8	9	9.67	7.56	-2.11	9	9.44	10.22	.78	-2.89
9	3	6.33	3.00	-3.33	3	6.33	7.67	1.34	-4.67
10	6	15.00	16.67	1.67	6	14.83	14.17	-.66	2.33
11	7	6.14	3.43	-2.71	7	6.14	5.14	-1.00	-1.71
12	7	7.29	12.43	5.14	7	6.57	10.29	3.72	1.42
13	7	6.29	8.86	2.57	7	6.29	6.71	.42	2.15
14	13	22.00	25.77	3.77	13	22.15	29.31	7.16	-3.39
15	11	29.64	31.27	1.63	11	30.27	31.00	.73	.90
16	12	28.58	31.00	2.42	12	28.17	30.33	2.16	.26
T	158	187.77	211.32	23.55	158	185.77	212.73	26.96	-3.41
M		11.74	13.21	1.47		11.61	13.30	1.68	-.21
Σx^2				162.59				127.44	105.78
T^2/n				34.66				54.39	.73
Σd^2				127.93				73.05	105.05
S.E.m				.73				.55	.66
t				2.01				3.07	.317
Per cent Level				10.00				1.00	80.00

levels. This fact indicates that the obtained difference may be regarded as approaching but not reaching statistical significance.⁷

The mean initial and final scores for the control group were 11.61 and 13.30 respectively. The mean gain in the reading achievement score in music was thus 1.68. The t-value of 3.07 for this difference exceeds the value (2.947) required for the one per cent level of significance for fifteen degrees of freedom. Accordingly, the difference may be regarded as statistically significant.

When the experimental and control groups were compared with respect to change in reading achievement score in music, the mean difference in gain was $-.21$, a difference in favor of the control group. The t-value for this difference is $.317$. A t-value of $.393$ would be exceeded by chance in seventy per cent of samples of this size, and a t-value of $.258$ would be exceeded by eighty per cent of samples of this size. Consequently, the difference of $.21$ in favor of the control group is not statistically significant.

The results summarized in Table 13, and discussed in the preceding paragraphs, support the following conclusions:

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In this experiment a difference was considered statistically significant, if the t-value for the difference was equal to or greater than the value needed for the one per cent level of confidence for the number of degrees of freedom involved.

(1) Both the experimental and control groups improved slightly in reading achievement scores in music between the initial and final tests. For the experimental group this improvement is not statistically significant; for the control group, the gain may be regarded as statistically significant, although it is negligible in gross size.

(2) The control group gained slightly more than the experimental group.

(3) The mean difference between the experimental and control groups, in improvement in score, is not statistically significant.

It will be recalled that the pupils in both the experimental and control groups were receiving music instruction in school classes. It was anticipated that both groups would improve in reading achievement in music due to instruction and maturity. Under the circumstances some gains in reading achievement would be expected whether the groups were taught by a reading method or not. A greater gain in reading achievement might be expected for the experimental group. Actually, very slight gains are found for the experimental and control groups. These gains probably are the result of the general music class instruction. They may also be, in part, the result of practice effect from one form of the test to the second form. The gains are so slight that they may be treated as negligible. The difference in gains, which favors the control groups, is almost certainly a matter of chance and not the result of training. No general improvement in power to read music was effected by

the experimental training method, so far as the evidence obtained by applying the small sample technique shows.

Reading Achievement Results Analyzed in Terms
of Large Group Comparisons

A second mode of statistical analysis.-- The data analyzed in the preceding section were treated on the assumption that each class was trained, or left untrained, as a unit, and that class differences are such that classes should be regarded as samples selected by chance out of a universe of classes. It is possible, however, to make a different set of assumptions, and to test the same data in a different manner in consequence. Thus it may be assumed that differences in the learning conditions from class to class were negligible, and that subdivision of the total number of subjects into classes was simply for convenience. It may further be assumed that the experimental variable of special instruction was applied uniformly to all subjects, or at least in a way not varying significantly from class to class.

If these latter assumptions are made, the appropriate statistical procedure becomes that of treating the subjects in the various experimental classes as all members of one group, with as many cases as subjects, namely, 158; treating the control-class subjects in the same fashion, as 158 paired cases; and applying the usual formula for standard error of the difference between means for correlated data.

Paired scores of pupils compared.-- The data neces-

sary for this second type of statistical treatment consist of individual scores for the subjects. The initial and final Knuth test scores of the individual pupils paired in the experimental and control groups are shown in Appendix A.

As in the earlier comparison of reading achievement, it was assumed that the instruction given to the experimental groups was effective only if the mean change in reading achievement of the group was greater than that of the control group by a statistically significant amount. Answers to these questions were sought:

(1) Was the change in reading achievement in music on the part of the experimental group statistically significant?

(2) Was the change in reading achievement on the part of the control group statistically significant?

(3) Was the difference between the experimental and control groups in reading achievement in music statistically significant, and which group did it favor?

It will be noted that these are the same questions asked and answered in the preceding section. They are repeated because of the use in the present section of a second statistical approach to their answer.

Statistical techniques used to determine the reliability of mean differences.---The original selection of pupils was based upon scores from the Knuth Test, form III - A. It will be recalled that the pupils were matched on the basis

of these scores and assigned to the experimental and control groups by random selection. For this reason the reliability measure used for the mean differences in initial and final scores of the groups was the standard error of a difference between the means of related variables.⁸

The statistical procedure may be described briefly as follows:

(1) The mean initial and final scores were determined for the pupils in both the experimental and control groups.

(2) The standard deviation of each distribution was calculated.

(3) Correlations were determined between the initial and final scores of the experimental group between the initial and final scores of the control group, and between the final scores of the experimental group and the final scores of the corresponding pupils of the control group.

(4) The standard error of each mean was calculated.

(5) The standard errors of the differences between original and final means of the experimental and control groups, and between the final means of the experimental and control groups, were established.

(6) The significance of each of these differences was established.

Initial reading achievement scores.-- Table 14 shows the initial scores in reading achievement, by grades

⁸ E. F. Lindquist, A First Course in Statistics, p. 125. Boston: Houghton-Mifflin Co., 1938.

TABLE 14

INITIAL READING ACHIEVEMENT SCORES OF EXPERIMENTAL AND CONTROL GROUPS ON KNUTH TEST III A

Experimental Group					Control Group			
Scores	Grade 7	Grade 8	Instru- mental	Total	Grade 7	Grade 8	Instru- mental	Total
38-40							1	1
35-37			6	6			7	7
32-34			5	5			3	3
29-31		1	3	4		1	6	7
26-28		3	3	6	1	1	2	4
23-25		2	8	10		4	4	8
20-22	1	2	7	10	1	2	6	9
17-19	4	3	2	9	2	5	5	12
14-16	5	9	1	15	3	4	2	9
11-13	3	8	1	12	6	12		18
8-10	4	14		18	4	12		16
5-7	7	10		17	6	10		16
2-4	11	7		18	12	9		21
0-1	22	6		28	22	5		27
Number	57	65	36	158	57	65	36	158
Mean	5.5	10.7	26.5	12.42	5.4	10.5	26.8	12.40
S. D.	6.2	7.4	6.5	10.45	6.2	6.2	7.1	10.65

and groups. The means and standard deviations are shown for separate sections and for the total number in the experimental and control groups. The initial mean of the entire experimental group is 12.42 as compared with 12.40 for the control group. The corresponding standard deviations are 10.45 and 10.65.

A few imperfectly matched cases, mentioned previously, cause the slight variations found in the total figures. The initial paired scores are closely matched.

Final reading achievement scores.-- The scores at the end of the experiment are shown in Table 15. The means and standard deviations are again shown for the subgroups as well as for the total groups. The final mean for the experimental group is 14.41, with a standard deviation of 12.02. The control group mean is 14.28, with a standard deviation of 11.39.

It will be noticed that the final mean of every subgroup in both the experimental and control groups is found to be higher than the corresponding initial mean.

Comparison of Table 15 with Table 13 reveals apparent discrepancies. The experimental group mean in Table 13, final score, is 13.21, and the control group mean is 13.30. In Table 15, the final means for these groups are 14.41 and 14.28, respectively. This variation is accounted for by the difference in treatment of scores. In the small sample technique each of the sixteen class groups was given equal weight in the final mean score. The class groups varied in size, however.

TABLE 15

FINAL READING ACHIEVEMENT SCORES OF EXPERIMENTAL AND CONTROL
GROUPS ON KNUTH TEST IIIB

Experimental Group					Control Group			
Scores	Grade 7	Grade 8	Instru- mental	Total	Grade 7	Grade 8	Instru- mental	Total
38-40			4	4			2	2
35-37		1	8	9			7	7
32-34		1	5	6		1	9	10
29-31		3	3	6		3	4	7
26-28	1	3	2	6	1	1	4	6
23-25	1	8	8	17		5	8	13
20-22	3	6	2	11	2	3	2	7
17-19	1	~	2	3	2	5		7
14-16	4	7	1	12	3	4		7
11-13	4	8	1	13	7	7		14
8-10	7	2		9	7	16		23
5-7	9	8		17	7	8		15
2-4	7	9		16	14	9		23
0-1	20	9		29	14	3		17
Number	57	65	36	158	57	65	36	158
Mean	6.63	13.11	29.17	14.41	6.32	12.09	30.25	14.28
S. D.	7.14	9.90	7.34	12.02	6.44	8.24	5.17	11.39

In the calculations reported in Tables 14 and 15, individuals rather than class groups are considered as units.

Differences between initial and final scores.-- Table 16 presents the comparative data for initial and final scores of the experimental and control groups. The initial mean of the experimental group is 12.42. The final mean is 14.41, with a gain of 1.99. The correlation between initial and final scores is .89. The difference in means (1.99) is statistically significant, as shown by the fact that it is more than four times the size of its standard error (.442).⁹ The critical ratio, i.e., the ratio of the difference to its standard error, is 4.5. From the data it may be stated that the gain in reading achievement by the experimental group was not due to chance.

The control group initial mean is 12.40, and final mean 14.28. The correlation between initial and final scores is .88. The difference between initial and final means (1.88) is statistically significant in view of the size of its standard error (.439). The critical ratio is 4.28. As with the experimental group, the gain in reading achievement by the control group was not due to chance.

Final score comparison.-- The final mean scores of the experimental and control groups are compared in Table 17. The experimental group mean is 14.41. The control group mean is 14.28. The difference is .13, in favor of the

⁹ The formula used was taken from E. F. Lindquist, A First Course in Statistics, p. 122. Boston: Houghton-Mifflin Co., 1938.

TABLE 16

DIFFERENCES BETWEEN INITIAL AND FINAL MEANS OF EXPERIMENTAL
AND CONTROL GROUPS IN READING ACHIEVEMENT

	Expital Group	Control Group
Final Mean	14.41	14.28
Initial Mean	12.42	12.40
Difference	1.99	1.88
Standard Error of Difference	.442	.439
Correlation Between Initial and Final Scores	.89	.88
Critical Ratio.....	4.50	4.28

TABLE 17

DIFFERENCE BETWEEN FINAL MEAN OF EXPERIMENTAL AND CONTROL
IN READING ACHIEVEMENT

Experimental Group Final Mean	14.41
Control Group Final Mean.....	14.28
Mean Difference.....	.13
Standard Error of Difference	.67
Correlation Between Final Scores	.86
Critical Ratio	.19

experimental group. The standard error of this difference is .67. The correlation of final scores is .86. The difference in favor of the experimental group is not statistically significant. The critical ratio is .19. Any difference in the groups at the close of the experiment is, therefore, presumably due to chance.

The results summarized in Tables 16 and 17, and discussed in the preceding paragraphs, support the following conclusions:

(1) Both the experimental and control groups improved slightly in reading achievement scores in music between the initial and final tests. For both of the groups the gain is statistically significant, although it is negligible in gross size.

(2) The mean difference between the experimental and control groups, in improvement in score, is not statistically significant.

These conclusions verify the results found in the preceding section and based on the small sample technique.

As stated earlier, any gain in reading achievement on the part of the experimental and control groups must thus be regarded as due to general instruction in music, to test-practice effect, and to increased maturity. A greater gain in reading achievement in music might be expected for the experimental group, if the training were influencing this achievement. Actually, small gains are found for both the experimental and control groups.

The difference in mean score, favoring the experimental group, is almost certainly a matter of chance and not the result of training. No general improvement in power to read music was effected by the experimental method.

Reading Performance of the Instrumental Players

Criteria for reading performance by the instrumental players.--- The effectiveness of the experimental lessons in producing gains in reading performance instrumentally, was determined by the index of reading performance, originated for the purpose in this study. It was again assumed that the instruction received by the experimental group was effective only if the mean change in reading achievement on the part of the experimental performers was greater than that of the control group by a statistically significant amount.

Answers were sought for these questions:

(1) Was there a statistically significant change in performance in reading music on the part of the instrumental players in the experimental group?

(2) Was there a statistically significant change in performance in reading music on the part of the instrumental players in the control group?

(3) Was there a statistically significant difference in performance in reading music between the experimental group of instrumental players and the control group of players, and which group did it favor?

Technique used in determination of reading performance ability.--- As already reported in the chapter in procedure,

each instrumental player in the experimental and the control groups was tested in sight reading ability while playing his instrument. An original measure, called, "The Index of Reading Performance," was established from the tests.

To repeat briefly, the index of reading performance was determined as the ratio of the sight reading index divided by the technical performance index. The technical performance index was the average number of notes played per second in an ascending and descending scale played as rapidly as possible by the performer in a way of his own choice and recorded by phonograph for accuracy of measurement. Variations in individual technical ability, variations in performance as a result of length of study as related to speed of performance, and variations in the inherent mechanical limits of various instruments, are accounted for in this index, if the player makes his performance a true display of his actual speed of technique.

The index of sight reading ability was obtained by having each player read at sight as rapidly and correctly as possible a passage involving notes of one rhythm value and arranged for proper registration of each instrument. This measure again was recorded and determined as the average number of notes played per second.

Special arrangements of the passages were made and many factors considered, as explained previously.

The final index of reading performance was obtained by dividing the sight reading index by the technical performance

index. This final index measured the player in performance of sight reading on the basis of technical ability to play his instrument.

Players on a variety of instruments were included in each group. The experimental group and control group each included thirty-six players, comprising ten trumpet players, nine clarinet players, five clarinet players, two alto saxophone players, two trombone players, three tuba players, and one player each of flute, oboe, bassoon, French horn, and cello.

It will be recalled that pupils in various classes were matched on the basis of the initial achievement score on the Knuth test. In the instrumental groups the matching was on the basis of the Knuth Test and the particular instrument performed. As a result, the final matching of scores on the Knuth test (finally shown in Table 23) was not quite as close in the instrumental groups as in the other classes.

Since the index of reading performance was finally to be used to measure the results of the training lessons for the experimental group, it was considered necessary for this study to keep the instrumentalists matched as to the instruments on which they performed. It seems likely, however, that further use of this measure may prove the technique reliable in comparing performance on different instruments, provided the conditions for establishing the index are observed.

Table 18 presents the initial index of reading performance for the thirty-six players in the experimental group.

TABLE 18

INITIAL INDEX OF READING PERFORMANCE OF THIRTY-SIX INSTRUMENTAL PLAYERS IN EXPERIMENTAL GROUP

Pupil	Number of Tones in Scale Passage	Time in Seconds	Index of Technical Performance	Number of Correct Tones in Sight Passage	Time in Seconds	Index of Sight Reading Speed	Index of Reading Performance
1	29	4.1	7.07	121	43.5	2.78	.323
2	26	3.9	6.67	126	52.5	2.40	.360
3	24	3.4	7.06	123	45.5	2.70	.383
4	29	5.1	5.69	121	54	2.24	.394
5	29	4	7.25	124	40.6	3.05	.421
6	31	7.4	4.19	124	66.1	1.88	.448
7	29	3.6	8.06	111	30	3.70	.459
8	27	3	9	119	28	4.25	.472
9	29	5.4	5.37	123	44.6	2.76	.514
10	32	8.9	3.60	120	63.3	1.90	.526
11	33	5	6.60	125	36	3.47	.526
12	29	5.7	5.09	121	44.2	2.75	.538
13	54	6.6	8.18	121	26.4	4.59	.560
14	29	4.4	6.59	129	34	3.79	.576
15	29	5.4	5.37	119	38.4	3.10	.577
16	32	7.3	4.38	127	46.4	2.74	.626
17	27	5.8	4.65	128	43.7	2.93	.629
18	29	5.1	5.69	124	34.2	3.63	.638
19	32	6.4	5.0	127	39.8	3.19	.638
20	29	5.3	5.47	121	34.1	3.55	.649
21	29	4.2	6.91	127	28.2	4.50	.652
22	33	4.6	7.17	124	26.4	4.70	.655
23	32	15.5	2.06	113	83.2	1.36	.659
24	64	9.6	6.67	129	29.3	4.40	.660
25	29	5.4	5.37	128	34.3	3.73	.695
26	29	5	5.8	128	31.4	4.08	.703
27	29	5.8	5.0	129	35.6	3.62	.725
28	57	9.7	5.88	125	28.7	4.36	.741
29	55	8.5	6.47	127	26.4	4.81	.743
30	57	7.5	7.60	123	21.5	5.72	.753
31	29	4.1	7.07	129	24.2	5.33	.754
32	28	4.5	6.22	128	26.5	4.83	.776
33	29	5.2	5.58	121	25.8	4.69	.841
34	29	4.2	6.91	128	22	5.82	.843
35	49	10.1	4.85	127	29.3	4.33	.893
36	30	4.8	6.25	128	22.3	5.74	.918
						M	.618
						S. D.	.149

The individual players are numbered according to their ranks on the final index. The range of the index of reading performance extends from .323 to .918. The mean score is .618 and the standard deviation .149.

An example of individual performance may be noted. Player 35 performed 49 notes in the scale passages in 10.1 seconds. This gives a technical performance index of 4.85 notes per second, one of the slower performances. In sight reading, this same player performed 127 notes correctly out of the possible 129, and played these in 29.3 seconds for a sight reading index of 4.33. When divided by the technical index of 4.85 this gives the final index of reading performance as .893, one of the higher indices. It may be considered that the reading performance of this player, of a particular technical skill rather limited as compared with the others, was .893 of his technical ability. Although he was slow in performance, his accuracy gave him one of the highest ratings for reading performance.

Sight reading in music.-- It may be observed that sight reading ability in musical performance is a specialized ability. Some of the best concert players are admittedly poor sight readers. Circumstances of performance by solo players need not demand the ability to read well at sight. Preparation of the particular selections can be made in private practice previous to any public playing.

Many solo players are facile sight readers.

Countless examples of solo players are found who are very able sight readers of music. Musicians who perform in groups with preparation limited to short practice periods must be able sight readers. Orchestral and band players, ensemble players, accompanists, and others who perform at sight constantly, must be able to read music rapidly and accurately.

The measurement of sight-reading ability in music involves complex considerations. The results may be better used to indicate areas where limitations may prove a handicap than as positive proof of ability in a particular field. Many other considerations enter into the preparation of a musician. Improvement in ability to read music is desirable, but may involve effort not commensurate with the result achieved. Measurement of sight-reading ability in music is still in its elementary stages of development. The index of performance in reading music at sight may be a help to establish a small area of the field.

Initial index of control group.-- Table 19 gives the initial index of reading performance for each instrumental player in the control group. The mean is .642 and the standard deviation .169. The members of the experimental and control groups, as stated before, were previously matched on the basis of the Knuth test scores and the particular instrument played. For this reason the instrumental players were not matched on the basis of the index of performance scores.

TABLE 19

INITIAL INDEX OF READING PERFORMANCE OF THIRTY-SIX INSTRUMENTAL
PLAYERS IN CONTROL GROUP

Pupil	Number of Tones in Scale Passage	Time in Seconds	Index of Technical Perfor- mance	Number of Correct Tones in Sight Passage	Time in Seconds	Index of Sight Reading Speed	Index of Reading Perfor- mance
1	29	5.3	5.47	126	26.5	4.76	.869
2	26	4	6.50	125	29.6	3.16	.486
3	30	4.4	6.82	123	36.5	3.37	.509
4	65	10.2	6.37	117	24.2	4.84	.759
5	49	4.4	11.1	128	25.3	5.06	.455
6	29	4.1	7.07	124	39.6	3.13	.413
7	29	4.8	6.04	129	48	2.69	.445
8	57	14.2	4.01	127	33.3	3.81	.950
9	30	6.3	4.76	120	40.1	2.99	.614
10	29	5.3	5.47	125	44.5	2.81	.513
11	29	4.4	6.59	129	21.7	5.94	.902
12	32	6.3	5.03	124	34.5	3.59	.708
13	32	6	5.33	122	32	3.81	.715
14	32	4.6	6.96	127	27.2	4.67	.671
15	32	6	5.33	121	27.8	4.35	.817
16	29	5.6	5.18	127	32.1	3.96	.764
17	31	7.7	4.03	124	61.4	2.02	.502
18	29	4.8	6.04	123	37	3.19	.528
19	33	5.4	6.11	129	26.2	4.92	.806
20	32	12.4	2.58	125	75.5	1.66	.642
21	45	6.4	6.72	114	48.9	2.33	.347
22	29	7.5	3.87	123	39.3	3.13	.809
23	33	6.2	5.32	128	36.6	3.50	.657
24	33	5.6	5.89	126	29.1	4.33	.735
25	60	9.6	6.25	124	45.1	2.75	.440
26	29	4.3	6.74	127	42.5	2.99	.443
27	33	6.8	4.85	120	50.2	3.97	.818
28	24	4.2	5.71	121	43.5	2.78	.487
29	29	5.3	5.47	126	36.7	3.43	.627
30	57	10.3	5.53	126	26.2	4.81	.869
31	31	6.3	4.92	123	38.3	3.21	.653
32	30	3.8	7.89	128	26.9	4.76	.603
33	29	5.1	5.68	127	36.4	3.49	.614
34	29	5.1	5.69	123	44.6	2.76	.485
35	33	5.4	6.11	125	38.6	3.24	.530
36	31	10	5.1	123	40.3	3.05	.984
M							.642
S. D.							.139

Nevertheless, the two groups were similar in composition, so far as the index of performance is concerned.

Table 20 shows that the mean index of the control group was .642, with a standard deviation of .169. The mean index for the experimental group was .618, with a standard deviation of .149. The control group started the experiment with a slight but negligible advantage over the experimental group.

Final index of performance.-- Table 21 presents the final index of reading performance for the experimental group. The mean is .642 and the standard deviation is .115. The correlation of initial and final scores is .66. The difference between the final mean (.642) and the initial mean (.618) is .024, indicating a slight gain. The standard error of this difference is .019, with a critical ratio of 1.26, indicating that the observed difference is of no statistical significance.

The final index of reading performance of each player in the control group is shown in Table 22. The mean is .698 and the standard deviation is .128. The correlation of initial and final scores is .67. The difference between final mean (.698) and initial mean (.642) represents a gain of .056, with a standard error of this difference of .021. The critical ratio is 2.67. This is somewhat less than the critical ratio (3) ordinarily required for assurance that a difference is not attributable to chance.

Comparison of final index of reading performance.-- In Table 23 a summary of all test data for the instrumental

TABLE 20

INITIAL MEAN INDEX AND STANDARD DEVIATION OF SCORES
IN READING PERFORMANCE FOR THE EXPERIMENTAL GROUP
AND THE CONTROL GROUP OF INSTRUMENTAL PLAYERS

	Experimental Group	Control Group
Mean	.618	.642
Standard Devia- tion	.149	.169

TABLE 21

FINAL INDEX OF READING PERFORMANCE OF THIRTY-SIX INSTRUMENTAL
PLAYERS IN EXPERIMENTAL GROUP

Pupil	Number of Tones in Scale Passage	Time in Seconds	Index of Technical Perfor- mance	Number of Correct Tones in Sight Passage	Time in Seconds	Index of Sight Read- ing Speed	Index of Read- ing Perfor- mance
1	27	4.2	6.43	120	39	3.08	.479
2	27	4	6.75	125	27.9	3.30	.489
3	27	4.3	6.28	127	39.5	3.22	.512
4	29	5.3	5.47	118	42.2	2.80	.511
5	27	4.3	6.28	126	31.8	3.96	.631
6	29	6.3	4.60	115	73	1.59	.342
7	29	3.6	8.06	120	23.4	5.13	.637
8	29	4	7.25	129	28.3	4.56	.629
9	29	5.7	5.09	129	40.3	3.20	.629
10	37	7.3	5.07	127	49	2.59	.511
11	29	3.8	7.63	124	31.8	3.90	.511
12	29	5.9	4.92	129	41.5	3.04	.618
13	29	4.8	6.04	127	23.8	5.34	.883
14	29	4.3	6.74	127	35.6	3.57	.529
15	57	8.7	6.55	125	34	3.68	.561
16	33	8.5	3.88	128	40	3.2	.824
17	29	5	5.8	129	36.7	3.52	.606
18	29	5.2	5.58	126	34.9	3.61	.647
19	32	5	6.40	129	33.4	3.86	.604
20	29	6	4.83	129	36	3.58	.742
21	27	3.6	7.5	125	25.4	4.92	.656
22	37	4.3	8.61	127	22.8	5.57	.647
23	35	12	2.92	129	70	1.84	.617
24	31	4.6	6.74	128	26.9	4.76	.706
25	37	7	5.29	129	36	3.58	.678
26	57	7.8	7.31	128	30	4.27	.584
27	33	5.6	5.89	124	36.2	3.43	.581
28	29	5.8	5.0	107	27.6	3.88	.775
29	28	4	7	123	28.6	4.30	.614
30	30	4.5	6.67	128	23.5	5.45	.817
31	29	4.2	6.91	126	23.5	5.36	.777
32	29	4.6	6.30	129	27.6	4.67	.742
33	31	5.4	5.74	126	26.3	4.79	.835
34	58	6.2	9.36	129	21.2	6.09	.651
35	49	9.4	5.21	127	30	4.2	.812
36	57	7.5	7.6	124	22.9	5.42	.713
							.642
							S. D. .115

TABLE 22

FINAL INDEX OF READING PERFORMANCE OF THIRTY-SIX INSTRUMENTAL
PLAYERS IN CONTROL GROUP

Pupil	Number of Tones in Scale Passage	Time in Seconds	Index of Technical Perfor- mance	Number of Correct Tones in Sight Passage	Time in Seconds	Index of Sight Read- ing Speed	Index of Reading Perfor- mance
1	29	5.1	5.87	124	27.7	4.48	.787
2	29	5.6	5.18	128	35.4	3.62	.698
3	29	4.2	6.905	127	31.2	4.07	.590
4	69	8.9	7.75	122	23.3	5.24	.675
5	25	4.3	5.81	84	18.1	4.64	.798
6	29	4.4	6.59	120	41.1	2.92	.443
7	30	5.2	5.77	120	46.1	2.60	.450
8	57	11.6	4.91	129	29	4.45	.905
9	29	6.4	4.53	124	42.3	2.93	.647
10	29	5.2	5.58	128	34.7	3.69	.661
11	57	8.6	6.63	127	22.7	5.60	.844
12	33	5.9	5.59	126	31	4.07	.727
13	29	5	5.8	124	32.7	3.76	.648
14	29	3.5	8.28	121	24.8	4.88	.674
15	31	5.9	5.25	122	28.1	4.34	.827
16	29	6.7	4.33	129	34.1	3.78	.874
17	29	6.3	4.60	126	53.6	2.35	.511
18	29	4.5	6.44	127	33.2	3.83	.594
19	29	4.4	6.59	125	26.6	4.7	.713
20	33	7.1	4.65	113	58.8	2.01	.432
21	29	4.4	6.59	120	38.9	3.09	.468
22	29	7.3	3.97	129	36.5	3.53	.890
23	33	7.1	4.65	124	35.4	3.5	.754
24	33	5.5	6.00	124	31	4.0	.667
25	57	8.6	6.63	122	35.1	3.48	.525
26	33	5.3	6.23	129	34.3	3.76	.604
27	65	13.3	4.89	129	33.8	3.82	.781
28	29	7.8	3.72	81	25.4	3.19	.858
29	29	6	4.83	114	28.4	4.02	.831
30	29	4.9	5.92	125	26.6	4.70	.794
31	20	6.6	4.55	124	34.3	3.62	.795
32	31	3.9	7.94	129	27.1	4.76	.600
33	31	6	5.17	126	35.1	3.59	.694
34	32	7.1	4.51	127	36.8	3.45	.766
35	29	5.2	5.58	124	30.3	4.09	.734
36	32	9.2	3.48	126	44.3	2.84	.818
						M	.698
						S. D.	.128

TABLE 23

INITIAL AND FINAL READING ACHIEVEMENT AND INDEX OF READING
PERFORMANCE SCORES FOR THIRTY-SIX INSTRUMENTAL PLAYERS OF
EXPERIMENTAL AND CONTROL GROUPS

Matched Pair of Pupils	Experimental Group				Control Group			
	Initial Reading Achieve- ment Score on Knuth Test	Final Read- ing Achieve- ment Score on Knuth Test	Initial Index Reading Perform- ance	Final Index Read- ing Perfor- mance	Initial Reading Achieve- ment Score on Knuth Test	Final Read- ing Achieve- ment Score on Knuth Test	Initial Index Reading Perform- ance	Final Index Reading Perform- ance
1	37	35	.323	.479	39	37	.869	.787
2	21	19	.360	.489	21	28	.486	.698
3	24	28	.383	.512	24	28	.509	.590
4	21	23	.394	.511	20	36	.759	.675
5	31	33	.421	.631	33	29	.455	.798
6	20	12	.448	.342	17	23	.413	.443
7	29	25	.459	.637	29	33	.445	.450
8	35	36	.472	.629	35	39	.950	.905
9	24	27	.514	.629	33	25	.614	.647
10	14	16	.526	.511	15	25	.513	.661
11	36	39	.526	.511	37	33	.902	.844
12	31	33	.538	.618	29	29	.708	.727
13	27	35	.560	.683	29	25	.715	.648
14	35	39	.576	.529	35	37	.671	.674
15	21	33	.577	.561	21	35	.817	.827
16	23	19	.626	.824	21	39	.764	.874
17	25	31	.629	.606	27	32	.502	.511
18	23	36	.638	.647	23	25	.528	.584
19	27	21	.638	.604	29	25	.806	.713
20	32	35	.649	.742	32	33	.642	.432
21	20	24	.652	.656	20	28	.347	.468
22	33	32	.655	.647	31	35	.809	.890
23	12	23	.659	.617	15	20	.657	.754
24	33	29	.660	.706	35	37	.735	.667
25	19	25	.695	.678	19	27	.440	.525
26	24	21	.703	.584	24	29	.443	.604
27	37	40	.725	.591	36	33	.818	.781
28	21	23	.741	.775	20	29	.437	.858
29	19	24	.743	.614	17	24	.627	.831
30	24	25	.753	.817	24	20	.869	.794
31	21	36	.754	.777	17	23	.653	.795
32	36	39	.776	.742	37	33	.603	.600
33	33	35	.841	.835	35	33	.614	.694
34	33	31	.843	.651	31	32	.485	.766
35	24	32	.893	.812	25	35	.530	.734
36	25	37	.918	.713	19	32	.984	.818
M	26.5	29.17	.618	.642	26.8	30.25	.642	.698
S. D.	6.5	7.34	.149	.115	7.1	5.17	.169	.128

players is presented. The initial and final scores for the Knuth tests, as well as the initial and final scores for the index of reading performance, are shown for both the experimental and control groups.

The difference between the final index for the control group, .698, and the final index for the experimental group .642, is .056, in favor of the control group. The correlation between the final scores is .13. The standard error of the difference is .027. The critical ratio is 2.07, suggesting that the difference lacks statistical significance.

The absence of any significant gain in reading performance on the part of the experimental group of instrumental players is of special interest. It will be recalled that the test materials making the index of performance measurements consisted of notes of a single rhythm value, offering the possibility of rapid performance without the limiting factor of having to respond to variations in rhythm. The musical excerpts used in the training lessons for the experimental group were also composed of notes of a single unit value. The attempt made in the training lessons was to develop the span of recognition of the players, so that in performance of the music the comprehension of the notation would not handicap the playing speed. It seemed reasonable to assume that the advantages of the training lessons would appear, if they were of any practical performance value, in the results measured by the index of reading performance on the part of the experimental group. Such is not the case. In fact, while all differences studied were of little

statistical significance and of negligible size, the control group did slightly better in reading during the final testing period than the experimental group. The difference is probably due to chance.

From the evidence of the Knuth test results and the index of reading performance results for the instrumental players it seems that any improvement in reading of music made possible by the tachistoscopic training reported in this study will not be observed in any practical situation involving reading and performance of music. It may be possible that under certain conditions of silent reading of music the type of training attempted here may prove of value. It seems likely that no practical application of such a skill can be made by many musicians. Possibly the skilled conductor may find the rapid observation of wide span of musical materials of great value in rapidly reading a score including many lines of musical notation. For the program of music education, such training seems definitely out of proportion in time and cost to any probable results in reading achievement.

Summary

This chapter has shown the results of the experimental training lessons upon achievement in reading music.

The experimental and control sections of pupils were first compared as class groups by means of the small sample technique. No significant difference in reading achievement was observed between the groups. Any slight

improvement observed in both groups may best be considered the result of general music class instruction and maturity.

The data were further treated in terms of comparisons of the experimental and control subjects, with all of the former regarded as a single group and all of the latter as a single group. The ordinary formula for determining the reliability of a difference between means was applied to the data. Again, no significant difference in final reading achievement was observed between the experimental and control groups. The observed slight improvement in each group was again considered the result of general music instruction and maturity.

Comparison of actual sight reading performance by the instrumental players in each group was also made. No difference of any statistical significance was observed in the performance of the instrumentalists in the experimental and control groups. This fact furnished practical evidence verifying the conclusions from the general group data relative to the value of the experimental training lessons.

By all results and comparisons of the data, the training lessons were shown to be of no value in improving achievement in reading music or in improving sight reading performance of music. All gains in reading achievement observed were negligible in size and can be attributed to general music class instruction and experience combined with maturity.

An incidental finding is that the index of reading

performance, used as a measure of instrumental sight reading, was shown to have some value as an elementary test of reading a particular kind of music.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Introduction

This chapter presents a summary of data and results from the preceding chapters. The conclusions are given, and their limitations are stated. In the final sections of the chapter, applications to practice are proposed, and suggested problems for further research are listed.

Summary

The problem.-- The major purpose of this investigation was to determine the effect upon achievement in reading music of a type of tachistoscopic training consisting of short exposures of musical units of increasing difficulty.

This study was shown to be significant both as a study in methods of instruction in reading music and as a study of transfer from training in a narrow function to skill in a broader function. Specific questions concerned the effect of training in recognition of musical materials during short exposures upon span of recognition in reading music and general achievement in reading music.

Literature on reading.-- Many applications of short-exposure training have been found in the teaching of reading. Considerable disagreement exists over the values of this work. Older studies and recent publications still recommend the practice, while some technical research has definitely

pointed out the limitations of tachistoscopic work. It has been stated by some that the direct values may not be commensurate with the time involved, although the interest and intangible results may be worthwhile.

Research in the reading of music is rather limited in amount and scope. The tachistoscopic studies thus far reported usually have been confined to small groups of skilled musicians. Practical application of the obtained results seems unlikely. Studies of eye movements and spacing of symbols have been made, and have some pertinence for this study.

Procedure.-- The study utilized an experimental procedure, with equivalent groups. The training of the experimental groups consisted of the short exposure of musical units flashed on a screen. The experiment was carried on in one school, Western Hills High School, Cincinnati, Ohio, with sixteen groups of subjects receiving training, and sixteen parallel groups not receiving the special training. The pupils were selected from vocal music classes of grades seven and eight and from the school orchestra and band. The subjects were matched on the basis of scores on the Knuth Achievement Tests in Music and assigned to experimental or control groups by random selection. The experimental and control groups each comprised 158 pupils. Thirty-six pairs of instrumental players were included in this number.

The equipment consisted of a lantern slide projector

with a flashmeter controlling the exposure, a screen, and lantern slides prepared by aid of a typewriter with musical symbols. Each slide included from two to seven notes extending over a staff interval range of a unison to a ninth. In general, the response required from the subjects consisted in reading of the musical units flashed on the screen.

Forty slides were used for each of the twenty lessons, one lesson each week. The first five lessons required the instrumental pupils to copy the exposed materials while the remaining subjects attempted to match the unit shown with the appropriate note pattern on a multiple-response form prepared for each lesson. For all later lessons all subjects responded by judging the musical unit shown on the screen to be identical with or different from a passage played by the experimenter on the piano. Following the first five lessons and preceding the last fifteen, a pre-test was given, consisting of the slides later presented as lesson XX. This pre-test gave a basis for comparison of initial achievement with final achievement, for the fifteen lessons in which the response required was a combination of visual and auditory discrimination. It also served to introduce the subjects to this mode of response.

As shown above in detail, the experimental variable was of a complex character, involving: a teaching procedure that included two types of response to the musical materials, one for the earlier lessons and a different response for the

later training; increased difficulty of the musical materials as training proceeded; and the addition of the training to the regular school music program for the experimental subjects.

Improvement in recognition of the flashed materials was analyzed in various ways. The mean score of the pupils for each training lesson was considered in relation to the difficulty of the materials used, as measured by the mean number of notes per slide and the mean staff interval range for each slide. The pre-test and final lesson data were compared. Average performance at successive lessons on certain slides was analyzed, the slides selected being substantially equal in difficulty.

General reading ability in music was measured at the beginning and end of the experiment by equivalent forms of the Knuth Tests. Statistical comparisons of the test scores for the experimental and control groups were made, both by the small sample technique and by analysis of the difference in mean scores of the groups.

The instrumental players in the groups were tested further by an initial and final measure of sight reading while playing. The performances of the players were phonographically recorded and were later analyzed. The criterion for achievement in sight reading was an original measure developed for this study, the index of sight reading performance.

Improvement in recognition-- The experimental subjects improved gradually during the training lessons in power to make correct responses to the visual-auditory sequence of stimuli presented. Evidence for this improvement was obtained

in three ways. (1) The average scores (number of correct responses) for the successive lessons were compared with the gradually increasing difficulty of the materials presented. In the last five lessons the trend of the mean scores was upward, although they were at the same time becoming more difficult. (2) Responses to one set of items presented first as a pre-test and later as the final lesson showed marked gains on the second presentation. (3) Analysis of responses to items of substantially equal difficulty from successive lessons showed a generally increasing number of correct responses from lesson to lesson. These results may be interpreted to mean that span of accurate recognition did actually increase as a result of tachistoscopic training.

General ability to read music: results from small sample technique.--- The results of the Knuth tests in reading achievement in music given to the experimental groups after training were compared with the results for the control groups by means of the small sample technique. The control groups were found to have made a significant gain in achievement. The experimental groups made a gain in achievement which approached significance. It was found, however, that the small advantage in final achievement shown by the control groups over the experimental groups was of no statistical significance. All gains were concluded to have resulted from the general musical instruction that all pupils received, from the test practice effect, or from the increasing maturity of the pupils, and not from the specific training program of this experiment.

General ability to read music: results from comparison of means of total groups.-- The data from the Knuth tests in reading music were also analyzed in terms of the mean differences between the experimental and control groups, taken as a whole. The results substantiate those obtained from the small sample technique, in almost every detail. Gain in achievement was shown by both the experimental and control sections. A small difference in final mean score was found to be of no significance.

Ability to read music: results from special tests of instrumental players.-- Separate data were secured for the instrumental players by the use of original tests yielding an index of sight-reading performance. The instrumental players improved slightly on this index in both experimental and control groups, from the beginning to the conclusion of the experiment, but not sufficiently to have statistical significance. The difference in final reading performance between the experimental and control groups of players was of no significance. The negligible advantage of the control group was probably due to chance.

The measure used to test the sight reading performance was found to have possibilities as an elementary device for testing sight reading performance of a particular type. The failure of the training lessons to result in any advantage for the experimental players over the control players was considered particularly significant. The experimental training was shown to be of the same type which the sight reading tests used. Any possible improvement in

- reading as a result of the experimental lessons should have been apparent in the index of sight-reading performance. It was concluded that the tachistoscopic training lessons were of no value in producing improved reading achievement under the conditions of this experiment.

Conclusions

Specific questions answered.-- From the results of this study the major questions raised may be answered thus:

(1) Training in recognition of musical materials during short exposures results in improved span of recognition in reading these materials.

(2) Such training has no effect upon general achievement in reading music.

The subordinate question raised may be answered thus:

The sight reading of certain kinds of music by instrumental players may be measured by the device developed for this study, the index of sight reading performance.

Values in the training.-- The value of this kind of training in span of recognition seems questionable in view of the findings. For the very skilled performer such an accomplishment may prove helpful, but for the purposes

of music education the lack of carry-over into reading achievement precludes the desirability of such a training technique. It may be found that interest in reading music may be increased by short exposure training lessons. The practical results expected in the form of improved reading achievement did not appear in this experiment.

The study may be used as evidence in the discussion of transfer of training. The particular improvement in reading the short exposure unit materials apparently did not operate to improve reading achievement of music written in grouped phrases. It is possible that, if the element of rhythmic training had been introduced into the tachistoscopic lessons, there would have been carry-over of improvement in this element or other identical components common in the true music-reading situation. Under the limitations of the training, however, it is possible to conclude that a mechanical development of a supposedly basal skill in reading the units of music produces no improvement in reading the true musical score. Identifying the patterns in practice caused no improvement when the situation was presented as a whole. In short, improving the recognition span for short musical excerpts does not operate to improve achievement in reading performance of music in general.

Limitations of the study.-- All data were gathered with one school as an experimental locale. The application of these results to general situations may be limited by

this factor. The training program involved various response methods and types of training rather than a single procedure. The design of the materials and the emphasis on improvement in span of recognition limited the area of the study. The difficulty of measurement in the reading of music also proved a limiting factor.

Recommended Investigations

Problems for further investigation.-- Music education needs further research on the reading of music.

In the use of short exposure devices, recommendations are now made that normal reading accompany such practice at each lesson. It is recommended that a thorough study of this plan of training be attempted with music, broadening the limits of this study and verifying this practice.

Further research should establish the index of sight reading performance as a measure of instrumental sight reading. This procedure may be shown to be a valid and reliable measure. With refinement and further experiment the index should prove a contribution to research in reading music.

Research should be able to establish a more adequate method of determining a response indicating ability to read music. The type of response required in this study is a common method of determining reading of music. With skilled players, direct performance may be used. For non-performing

readers of music, it seems likely that a better response indicating reading accomplishment may be found.

Applications

Applications of the study.-- The use of tachistoscopic training is not recommended as a practice for music education. The time, expense, and limits of the training method outweigh the possible development of interest as a value in this work. On the other hand, the results are in line with those of studies in general reading which support the use of large units of meaningful material from the beginning, with the learning of vocabulary skills in a natural setting rather than in isolation. The method of teaching the reading of music should then be similar to the best methods developed for teaching the reading of verbal material.

The index of sight-reading performance has positive application in music education. While this study applied the technique only to instrumental music, some parallel measure could be developed for vocal music when technical skill is emphasized. The measurement of performance skill is a demand of music education. The use of the index of sight-reading performance creates an objective device for the measurement of performance skill in one musical area. All musicians consider sight reading as an element of musicianship. It is recognized that many other elements of musicianship remain to be measured objectively.

The study may have broader applications to methods of teaching music. The lack of transfer of the ability developed in reading the training materials to reading actual music may have general significance. Much use is made of isolated training materials in developing technique in musical performance. This study shows that the use of the isolated practice in reading did not produce achievement in reading actual music. The use of similar isolated reading drills may be questioned. The teaching of music has made use of such training. The practical value of such isolated drills may well be considered as requiring objective proof, if they are to continue to claim the time and energy of music students and teachers. Some drill procedures may be of definite value. It is reasonable to assume, however, that some drill procedures now considered to have transfer value may not be producing the results expected.

The findings are in general negative, so far as the teaching procedure under investigation is concerned. In a sense, it appears that the lack of transfer from the short-exposure training to general reading of music indicates that the addition of this training was wasteful of the time of those pupils given it. This statement is true, if other possible values in the training are disregarded. However, findings against a procedure may be as enlightening as findings in behalf of one. The present study will have served a useful purpose, if it encourages a more critical attitude toward highly analytical

drill procedures, both in the teaching of reading music and in the general field of reading instruction, than is today common.

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APPENDIX A

TABLE 24

BASIC DATA FROM KNUTH TEST: INITIAL AND FINAL SCORES FOR
INDIVIDUAL PUPILS

Grade Group	Pupil No.	Experimental Group		Control Group	
		Initial Score	Final Score	Initial Score	Final Score
Grade 7, Group 1, Boys	1	0	4	0	4
	2	0	1	0	6
	3	1	13	1	7
	4	1	4	1	0
	5	4	6	4	5
	6	5	0	4	12
	7	7	12	7	10
	8	8	5	9	12
	9	12	12	12	12
	10	16	20	11	15
	11	16	27	15	11
	12	19	24	28	28
Grade 7, Group 2, Girls	1	0	0	0	0
	2	3	5	3	2
	3	4	1	4	2
	4	4	8	8	4
	5	4	8	4	3
	6	11	0	13	12
	7	15	15	15	19
	8	16	10	13	9
	9	17	21	15	16
	10	19	16	20	21
Grade 7, Group 3, Boys	1	0	1	0	0
	2	0	9	0	1
	3	1	1	1	0
	4	3	0	3	2
	5	3	7	3	0
	6	5	0	3	1
	7	5	1	5	10
	8	5	3	5	11
	9	8	3	7	10
	10	9	8	9	4
	11	17	13	12	7

TABLE 24 (Continued)

Grade Group	Pupil No.	Experimental Group		Control Group	
		Initial Score	Final Score	Initial Score	Final Score
Grade 7, Group 4, Girls	1	0	0	0	3
	2	0	0	0	7
	3	0	0	0	4
	4	0	1	0	1
	5	0	5	0	8
	6	1	0	1	1
	7	1	5	0	0
	8	1	8	1	9
	9	3	0	3	1
	10	12	15	12	17
	11	19	17	18	20
Grade 7, Group 5, Boys	1	0	0	0	4
	2	0	0	0	6
	3	0	3	0	0
	4	0	3	0	0
	5	0	5	0	2
	6	0	7	0	3
	7	3	0	3	0
	8	4	7	4	3
	9	4	8	3	5
	10	5	3	5	3
	11	5	15	7	13
	12	8	0	8	10
	13	20	21	19	16
Grade 8, Group 6, Boys	1	9	0	9	6
	2	9	4	9	8
	3	13	23	13	10
	4	15	21	11	18
	5	16	21	19	14
	6	28	31	28	29

TABLE 24 (Continued)

Grade Group	Pupil No.	Experimental Group		Control Group	
		Initial Score	Final Score	Initial Score	Final Score
Grade 8, Group 7, Girls	1	5	12	5	15
	2	8	24	8	12
	3	9	5	7	9
	4	9	11	11	24
	5	11	15	11	16
	6	12	11	12	12
	7	16	9	16	19
	8	16	21	17	15
	9	20	24	20	31
	10	21	23	20	24
	11	23	29	24	31
	12	27	25	25	27
Grade 8, Group 8, Boys	1	4	3	4	0
	2	4	4	4	3
	3	5	0	5	8
	4	5	3	5	1
	5	8	7	8	7
	6	8	7	8	8
	7	9	0	9	9
Grade 8, Group 9, Girls	1	4	13	4	9
	2	4	15	4	1
	3	7	11	7	8
	4	8	16	7	10
	5	9	28	9	9
	6	11	23	11	20
	7	11	32	11	12
	8	12	20	12	23
	9	15	23	15	20
	10	16	15	16	2
	11	17	15	17	13
	12	19	21	19	22
	13	24	27	23	12
	14	27	31	29	32

TABLE 24 (Continued)

Grade Group	Pupil No.	Experimental Group		Control Group	
		Initial Score	Final Score	Initial Score	Final Score
Grade 8, Group 10 Boys	1	0	3	0	4
	2	1	11	1	10
	3	1	15	1	7
	4	4	3	4	4
	5	7	12	8	3
	6	9	6	9	19
	7	29	37	28	25
Grade 8, Group 11, Girls	1	3	1	3	5
	2	5	0	4	7
	3	5	5	5	9
	4	8	5	7	5
	5	9	5	8	8
	6	11	1	11	10
	7	12	27	12	13
	8	15	4	16	18
	9	19	20	19	25
Grade 8, Group 12, Boys	1	0	3	0	2
	2	1	4	3	4
	3	1	5	1	2
	4	5	12	5	2
	5	7	0	9	7
	6	15	15	13	13
	7	15	23	15	17
Grade 8, Group 13, Girls	1	4	0	4	8
	2	7	8	7	8
	3	8	1	8	7

TABLE 24 (Continued)

Grade Group	Pupil No.	Experimental Group		Control Group	
		Initial Score	Final Score	Initial Score	Final Score
Instru- mental Group 14	1	12	23	15	20
	2	14	16	15	25
	3	19	24	17	24
	4	19	25	19	27
	5	20	12	17	28
	6	21	25	20	29
	7	21	23	20	36
	8	21	33	21	35
	9	24	21	24	29
	10	24	32	25	35
	11	25	31	27	32
	12	31	33	33	29
	13	35	39	35	37
Instru- mental Group 15	1	21	36	17	23
	2	23	19	21	39
	3	24	27	33	25
	4	27	21	29	25
	5	27	35	29	25
	6	29	25	29	33
	7	32	35	32	33
	8	33	32	31	35
	9	36	39	37	33
	10	37	35	39	37
	11	37	40	36	33
Instru- mental Group 16	1	20	24	20	28
	2	21	19	21	28
	3	24	25	24	20
	4	24	28	24	28
	5	25	37	19	32
	6	28	36	28	25
	7	31	33	29	29
	8	33	29	35	37
	9	33	31	31	32
	10	33	35	35	33
	11	35	36	35	39
	12	36	39	37	33

TABLE 25
AGES OF SUBJECTS AT BEGINNING OF EXPERIMENT

Age in Months	Frequencies	
	Experimental Group	Control Group
197-199	1	
194-196	2	2
191-193	2	3
188-190	4	5
185-187	5	3
182-184	4	7
179-181	8	6
176-178	17	16
173-175	20	22
170-172	21	24
167-169	22	19
164-166	18	20
161-163	11	13
158-160	13	10
155-157	5	3
152-154	3	4
149-151	2	1
N.	158	158
M.	171.34	171.04
S. D.	9.40	9.17

TABLE 26
PERCENTILE RANKS OF SUBJECTS ON OTIS
GROUP INTELLIGENCE TEST

P. R. Scores	Frequencies	
	Experimental Group	Control Group
97-99	4	3
94-96	10	12
91-93	14	12
88-90	19	23
85-87	22	20
82-84	18	17
79-81	11	16
76-78	13	9
73-75	11	13
70-72	7	7
67-69	5	8
64-66	8	4
61-63	3	4
58-60	5	3
55-57	4	2
52-54	1	1
49-51	2	3
46-48		1
43-45	1	
N.	158	158
M	80.13	80.63
S. D.	10.10	11.12

APPENDIX B

MUSICAL UNITS USED IN TRAINING LESSONS

MUSICAL UNITS FOR LESSONS I, VI, II, AND VII

I, VI

1 2 3 4 5 6 7 8 9 10 11 12

13 14 15 16 17 18 19 20 21 22 23

24 25 26 27 28 29 30 31 32

33 34 35 36 37 38 39 40

II, VII

1 2 3 4 5 6 7 8 9 10 11 12 13

14 15 16 17 18 19 20 21 22 23 24

25 26 27 28 29 30 31 32 33

34 35 36 37 38 39 40

MUSICAL UNITS FOR LESSONS III, VIII, IV, AND IX

III - VIII

1 2 3 4 5 6 7 8 9 10 11 12 13

14 15 16 17 18 19 20 21 22 23 24

25 26 27 28 29 30 31 32 33

34 35 36 37 38 39 40

IV - IX

1 2 3 4 5 6 7 8 9 10 11 12 13

14 15 16 17 18 19 20 21 22 23 24

25 26 27 28 29 30 31 32 33

34 35 36 37 38 39 40

The image displays two sets of musical exercises, labeled 'III - VIII' and 'IV - IX'. Each set is presented on four staves of music. The first set (III - VIII) contains measures 1 through 40, and the second set (IV - IX) also contains measures 1 through 40. The notation is written on a five-line staff with a treble clef. It includes various musical symbols such as notes (quarter, eighth, and sixteenth notes), rests, and bar lines. The exercises are designed for lessons III, VIII, IV, and IX.

MUSICAL UNITS FOR LESSONS V, X, AND XI

V-X

1 2 3 4 5 6 7 8 9 10 11 12 13

14 15 16 17 18 19 20 21 22 23

24 25 26 27 28 29 30 31 32

33 34 35 36 37 38 39 40

XI

1 2 3 4 5 6 7 8 9 10 11 12 13

14 15 16 17 18 19 20 21 22 23 24

25 26 27 28 29 30 31 32 33

34 35 36 37 38 39 40

MUSICAL UNITS FOR LESSONS XII AND XIII

XII

1 2 3 4 5 6 7 8 9 10 11 12

13 14 15 16 17 18 19 20 21 22 23

24 25 26 27 28 29 30 31 32

33 34 35 36 37 38 39 40

XIII

1 2 3 4 5 6 7 8 9 10 11

12 13 14 15 16 17 18 19 20 21 22

23 24 25 26 27 28 29 30 31 32

33 34 35 36 37 38 39 40

MUSICAL UNITS FOR LESSONS XIV AND XV

1 XIV 2 3 4 5 6 7 8 9 10

11 12 13 14 15 16 17 18 19

20 21 22 23 24 25 26 27 28 29

30 31 32 33 34 35 36 37

38 39 40 1 XV 2 3 4 5

6 7 8 9 10 11 12 13

14 15 16 17 18 19 20 21 22

23 24 25 26 27 28 29 30 31

32 33 34 35 36 37 38 39 40

MUSICAL UNITS FOR LESSONS XVI AND XVII

1 XVI 2 3 4 5 6 7 8 9 10

11 12 13 14 15 16 17 18 19

20 21 22 23 24 25 26 27 28

29 30 31 32 33 34 35 36 37

38 39 40 1 XVII 2 3 4 5

6 7 8 9 10 11 12 13 14

15 16 17 18 19 20 21 22 23

24 25 26 27 28 29 30 31

32 33 34 35 36 37 38 39 40

MUSICAL UNITS FOR LESSONS XVIII AND XIX

1 ~~XIX~~ 2 3 4 5 6 7 8

9 10 11 12 13 14 15 16 17

18 19 20 21 22 23 24 25 26

27 28 29 30 31 32 33 34

35 36 37 38 39 40 ~~XIX~~ 1 2

3 4 5 6 7 8 9 10 11 12

13 14 15 16 17 18 19 20 21 22

23 24 25 26 27 28 29 30 31 32

33 34 35 36 37 38 39 40



MUSICAL UNITS FOR LESSON XX

Musical notation for Lesson XX, units 1 to 40. The notation is arranged in six staves, each containing a sequence of musical units. The units are numbered 1 through 40. The notation includes various musical symbols such as notes, rests, and bar lines. The first unit (1) is marked with a double 'X' above it. The notation is written on a five-line staff with a key signature of one flat (B-flat) and a common time signature (C). The units are grouped into six staves: the first staff contains units 1-7, the second 8-15, the third 16-22, the fourth 23-28, the fifth 29-34, and the sixth 35-40. The notation is written in a clear, legible style, with notes and rests clearly defined. The units are numbered 1 through 40, with the first unit (1) marked with a double 'X' above it. The notation is written on a five-line staff with a key signature of one flat (B-flat) and a common time signature (C). The units are grouped into six staves: the first staff contains units 1-7, the second 8-15, the third 16-22, the fourth 23-28, the fifth 29-34, and the sixth 35-40. The notation is written in a clear, legible style, with notes and rests clearly defined.

APPENDIX C

NOTES PLAYED ON PIANO FOR CERTAIN ITEMS
OF LESSONS VI THROUGH XXNOTES PLAYED ON PIANO FOR CERTAIN ITEMS
OF LESSONS VI, VII, VIII, AND IX

VI

3 7 8 10 11 14 15 16 19 20 22

25 26 28 30 32 33 34 35 38 40

VII

2 3 6 8 10 11 15 16 17 18 22 24 25

28 31 34 37 39 40

VIII

2 3 5 9 11 13 14 18 20 21 23

24 26 27 29 30 32 35 36 38 39

IX

4 7 9 10 11 13 15 16 18 21 25

26 28 29 32 35 36 39 40

NOTES PLAYED ON PIANO FOR CERTAIN ITEMS
OF LESSONS X, XI, XII, AND XIII

X

2 3 5 8 10 11 14 15 16 19 20 22

23 25 27 28 29 32 33 35 36 39 40

XI

3 4 6 10 12 14 16 17 19 21 22

23 24 26 27 28 30 32 35 36 38

XII

3 4 7 8 11 15 16 17 20 22

23 25 26 29 31 33 34 37 38

XIII

3 4 6 8 10 11 14 16 20

22 23 27 29 31 33 34 35 37

NOTES PLAYED ON PIANO FOR CERTAIN ITEMS
OF LESSONS XIV, XV, XVI, AND XVII

XIV

1 4 6 7 10 12 13 16 19 21

23 26 27 28 30 31 33 34 36 38

XV

3 4 5 7 9 10 12 14 17 18

22 25 27 28 30 31 33 36 37 40

XVI

3 6 7 8 10 13 14 16 18

22 23 24 27 28 31 34 36 37 40

XVII

5 6 9 10 12 13 16 17 19

21 22 24 27 28 32 33 35 36 39

NOTES PLAYED ON PIANO FOR CERTAIN ITEMS
OF LESSONS XVIII, XIX, AND XX

XVIII

2 5 7 8 10 11 13 16 18 20

21 22 24 26 27 28 31 33 37 39

XIX

4 8 9 12 13 15 17 18 20

22 23 26 29 30 31 33 34 36 39

XX

5 7 8 9 13 15 16 18 19

23 24 25 27 30 31 34 35 37 40

The image displays three sets of musical notation, each for a different piano exercise. Exercise XVIII consists of two staves of music with notes numbered 2 through 39. Exercise XIX also consists of two staves with notes numbered 4 through 39. Exercise XX consists of two staves with notes numbered 5 through 40. The notation includes various musical symbols such as clefs, time signatures, and note heads, with the numbers placed above the notes to indicate specific fingerings or sequences.

APPENDIX D

ANSWER SHEETS FOR VARIOUS LESSONS

ANSWER SHEET FOR INSTRUMENTAL
PLAYERS USED IN LESSONS I THROUGH V

ANSWER SHEET FOR WRITTEN NOTES. NAME _____

Home Room _____ Grade and Group _____ Date _____ Bell _____ Test No. _____ SCORE _____

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35
36	37	38	39	40

ANSWER SHEET FOR MULTIPLE RESPONSE MATCHING
IN LESSONS I THROUGH V

ANSWER SHEET FOR MULTIPLE CHOICE. NAME _____
Home Room _____ Grade and Group _____ Date _____ Bell _____ Test No. _____ Score _____

- | | | | |
|-------------|-------------|-------------|-------------|
| 1. A B C D | 11. A B C D | 21. A B C D | 31. A B C D |
| 2. A B C D | 12. A B C D | 22. A B C D | 32. A B C D |
| 3. A B C D | 13. A B C D | 23. A B C D | 33. A B C D |
| 4. A B C D | 14. A B C D | 24. A B C D | 34. A B C D |
| 5. A B C D | 15. A B C D | 25. A B C D | 35. A B C D |
| 6. A B C D | 16. A B C D | 26. A B C D | 36. A B C D |
| 7. A B C D | 17. A B C D | 27. A B C D | 37. A B C D |
| 8. A B C D | 18. A B C D | 28. A B C D | 38. A B C D |
| 9. A B C D | 19. A B C D | 29. A B C D | 39. A B C D |
| 10. A B C D | 20. A B C D | 30. A B C D | 40. A B C D |

ANSWER SHEET FOR LESSONS
VI THROUGH XX

ANSWER SHEET FOR DUPLER RESPONSE SERIES, NAME _____

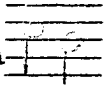
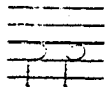
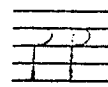
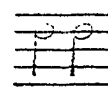
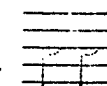
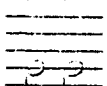
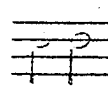
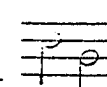
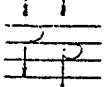
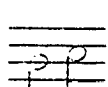
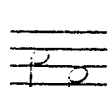
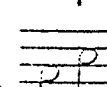
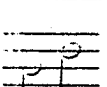
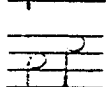
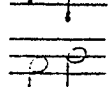
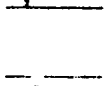
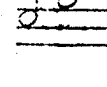
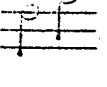
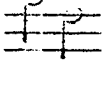
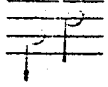
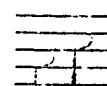
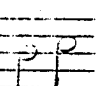
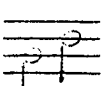
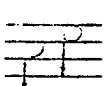
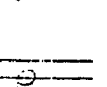
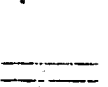
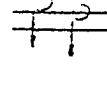
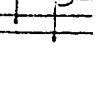
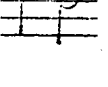
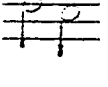
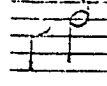
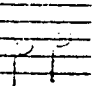
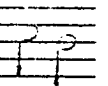
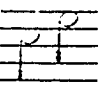
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2. S D	12. S D	22. S D	32. S D	
3. S D	13. S D	23. S D	33. S D	
4. S D	14. S D	24. S D	34. S D	
5. S D	15. S D	25. S D	35. S D	
6. S D	16. S D	26. S D	36. S D	
7. S D	17. S D	27. S D	37. S D	
8. S D	18. S D	28. S D	38. S D	
9. S D	19. S D	29. S D	39. S D	
10. S D	20. S D	30. S D	40. S D	

APPENDIX E
MULTIPLE CHOICE RESPONSE SHEETS FOR
LESSONS I THROUGH V

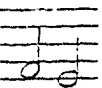
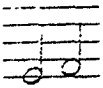
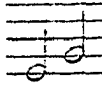
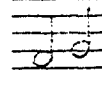
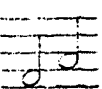
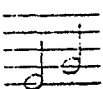
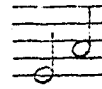
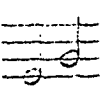
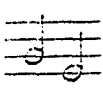
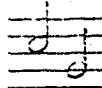
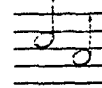
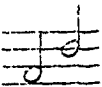
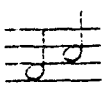
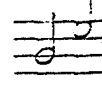
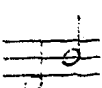
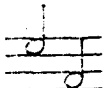
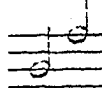
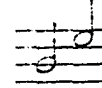
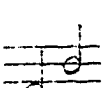
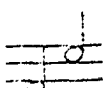
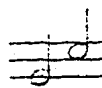
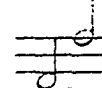
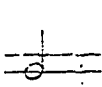
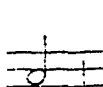
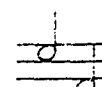
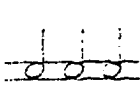
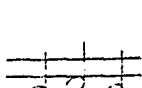
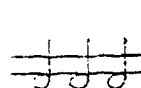
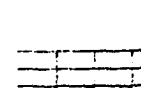
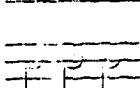
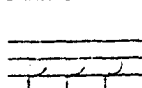
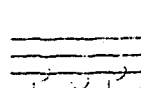
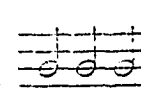
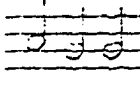
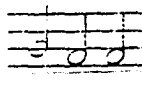
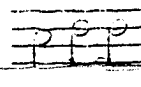
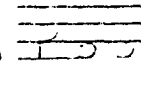
MULTIPLE CHOICE RESPONSE SHEET FOR LESSON I, PAGE 1

Multiple Choice Response Sheet. Series A, page 1.

Mark answers on other sheet, no marks are to be made on this paper.

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2	A 	B 	C 	D 
3	A 	B 	C 	D 
4	A 	B 	C 	D 
5	A 	B 	C 	D 
6	A 	B 	C 	D 
7	A 	B 	C 	D 
8	A 	B 	C 	D 
9	A 	B 	C 	D 
10	A 	B 	C 	D 

MULTIPLE CHOICE RESPONSE SHEET
 FOR LESSON I, PAGE 1 (Continued)

11 A 	B 	C 	D 
12 A 	B 	C 	D 
13 A 	B 	C 	D 
14 A 	B 	C 	D 
15 A 	B 	C 	D 
16 A 	B 	C 	D 
17 A 	B 	C 	D 
18 A 	B 	C 	D 
19 A 	B 	C 	D 
20 A 	B 	C 	D 

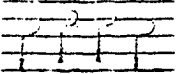
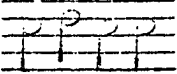
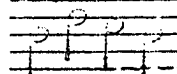
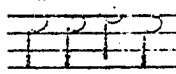
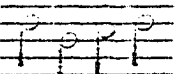
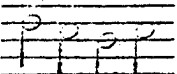
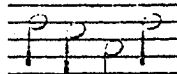
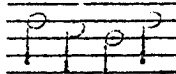
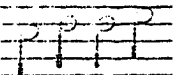
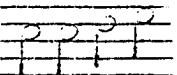
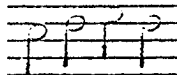
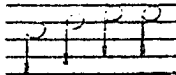
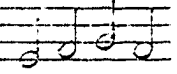
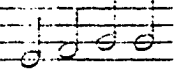
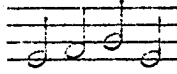
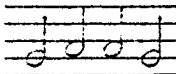
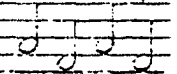
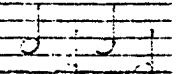
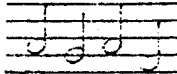
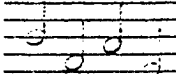
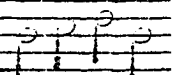
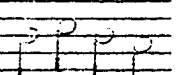
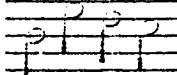
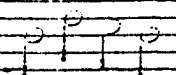
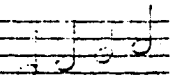
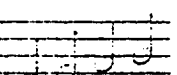
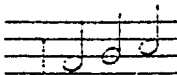
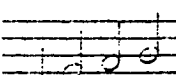
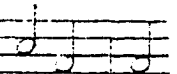
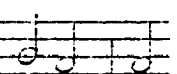
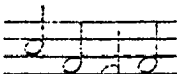
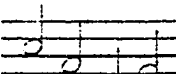
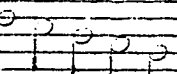
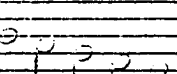
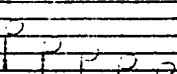
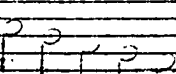
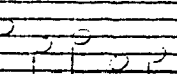
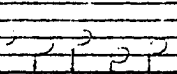
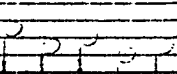
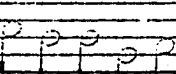
MULTIPLE CHOICE RESPONSE SHEET
FOR LESSON 1, PAGE 2

Multiple Choice Response sheet. Series A, sheet 2.

Mark answers on other sheet, no marks are to be made on this paper.

21 A	B	C	D
22 A	B	C	D
23 A	B	C	D
24 A	B	C	D
25 A	B	C	D
26 A	B	C	D
27 A	B	C	D
28 A	B	C	D
29 A	B	C	D
30 A	B	C	D

MULTIPLE CHOICE RESPONSE SHEET
FOR LESSON I, PAGE 2 (Continued)

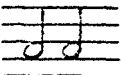
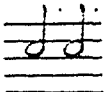
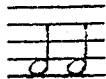
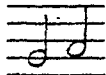
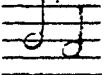
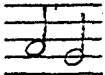
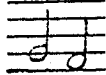
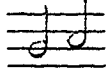
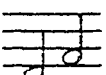
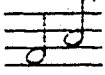
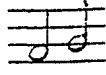
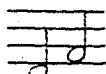
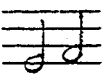
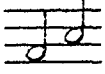
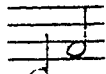
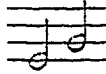
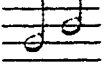
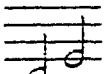
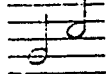
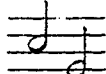
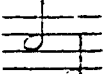
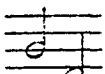
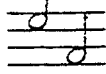
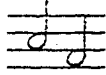
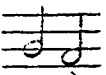
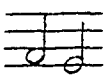
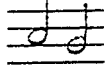
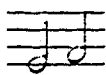
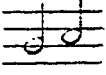
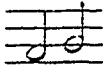
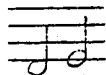
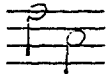
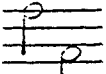
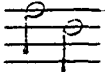
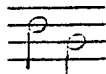
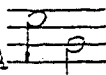
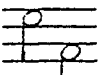
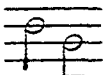
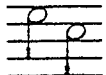
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36 A		B		C		D	
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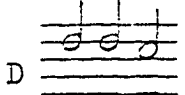
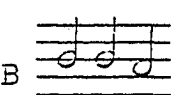
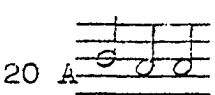
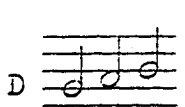
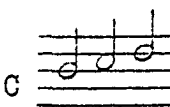
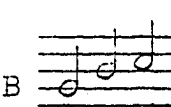
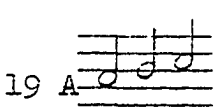
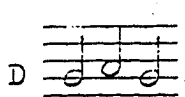
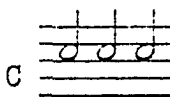
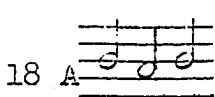
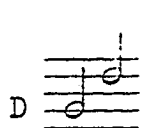
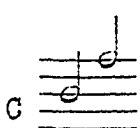
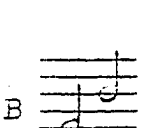
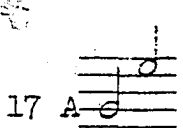
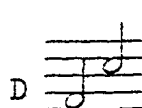
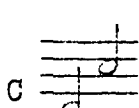
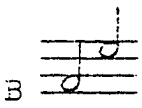
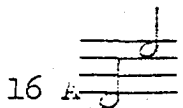
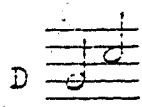
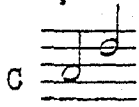
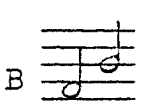
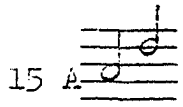
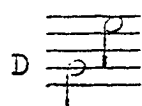
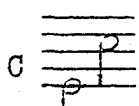
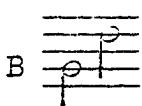
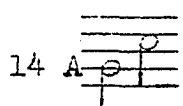
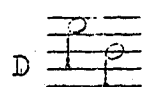
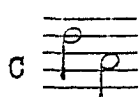
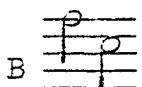
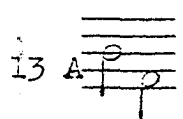
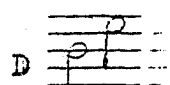
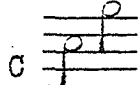
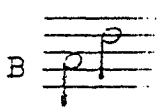
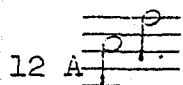
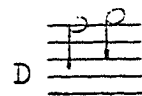
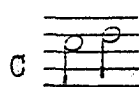
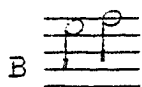
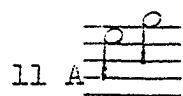
MULTIPLE CHOICE RESPONSE SHEET
FOR LESSON II, PAGE 1

MULTIPLE RESPONSE SHEET SERIES B $\bar{B}$, page 1.

B,

MARK ALL ANSWERS ON THE OTHER SHEET, NO WRITING ON THIS PAGE

1A 	B 	C 	D 
2 A 	B 	C 	D 
3 A 	B 	C 	D 
4 A 	B 	C 	D 
5 A 	B 	C 	D 
6 A 	B 	C 	D 
7 A 	B 	C 	D 
8 A 	B 	C 	D 
9 A 	B 	C 	D 
10 A 	B 	C 	D 

MULTIPLE CHOICE RESPONSE SHEET
FOR LESSON II, PAGE 1 (Continued)

MULTIPLE CHOICE RESPONSE SHEET
FOR LESSON II, PAGE 2

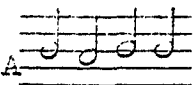
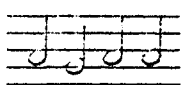
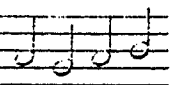
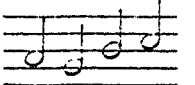
MULTIPLE CHOICE RESPONSE SHEET SERIES B, page 2.

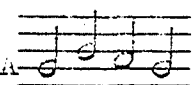
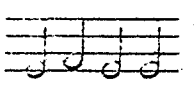
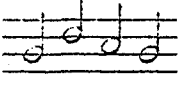
B, 2

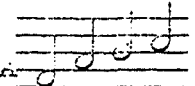
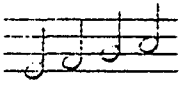
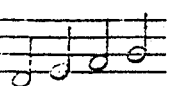
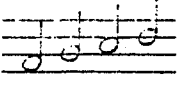
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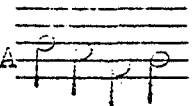
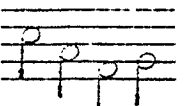
21	A	B	C	D
22	A	B	C	D
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24	A	B	C	D
25	A	B	C	D
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29	A	B	C	D
30	A	B	C	D

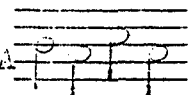
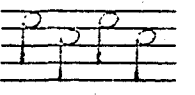
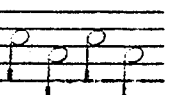
MULTIPLE CHOICE RESPONSE SHEET
FOR LESSON II, PAGE 2 (Continued)

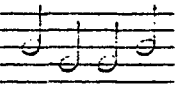
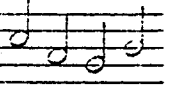
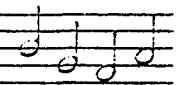
31 A  B  C  D 

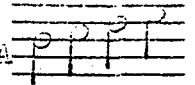
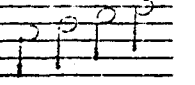
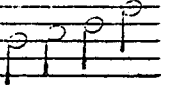
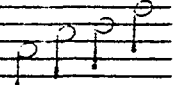
32 A  B  C  D 

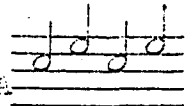
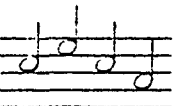
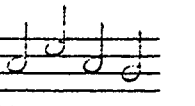
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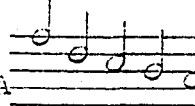
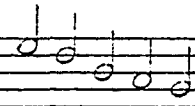
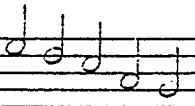
34 A  B  C  D 

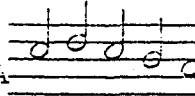
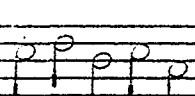
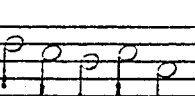
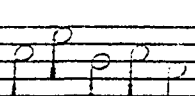
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36 A  B  C  D 

37 A  B  C  D 

38 A  B  C  D 

39 A  B  C  D 

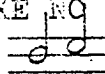
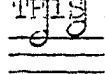
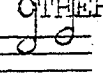
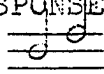
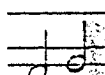
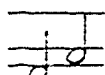
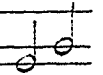
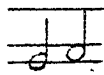
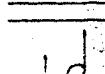
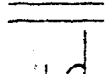
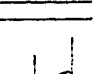
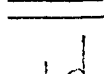
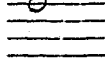
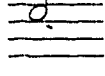
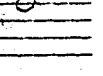
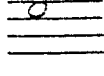
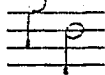
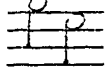
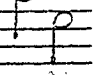
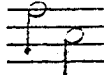
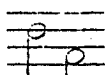
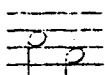
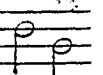
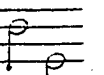
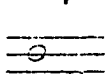
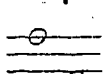
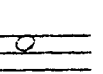
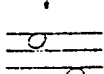
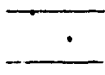
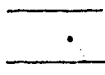
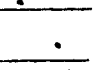
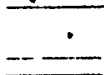
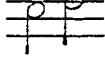
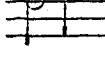
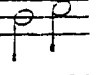
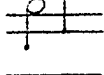
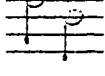
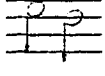
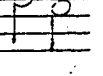
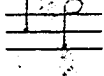
40 A  B  C  D 

MULTIPLE CHOICE RESPONSE SHEET
FOR LESSON III, PAGE 1

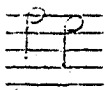
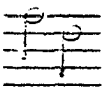
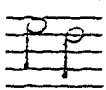
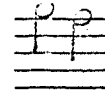
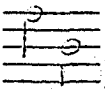
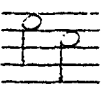
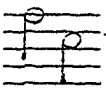
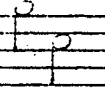
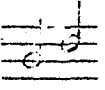
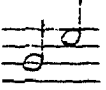
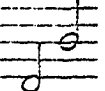
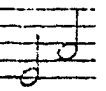
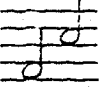
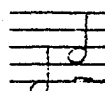
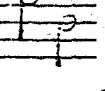
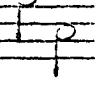
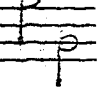
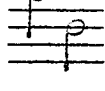
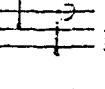
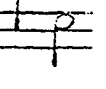
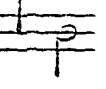
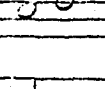
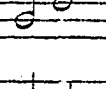
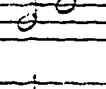
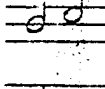
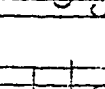
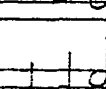
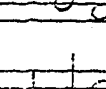
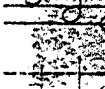
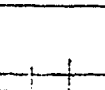
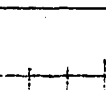
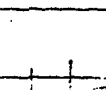
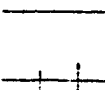
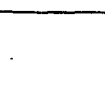
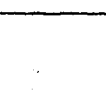
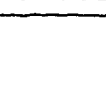
MULTIPLE RESPONSE SHEET. SERIES C, page 1.

C

MAKE NO MARKS ON THIS PAPER, USE OTHER SHEET FOR RESPONSES

1 A 	B 	C 	D 
2 A 	B 	C 	D 
3 A 	B 	C 	D 
4 A 	B 	C 	D 
5 A 	B 	C 	D 
6 A 	B 	C 	D 
7 A 	B 	C 	D 
8 A 	B 	C 	D 
9A 	B 	C 	D 
10 A 	B 	C 	D 

MULTIPLE CHOICE RESPONSE SHEET
FOR LESSON III, PAGE 1 (Continued)

11 A 	B 	C 	D 
12 A 	B 	C 	D 
13 A 	B 	C 	D 
14 A 	B 	C 	D 
15 A 	B 	C 	D 
16 A 	B 	C 	D 
17 A 	B 	C 	D 
18 A 	B 	C 	D 
19 A 	B 	C 	D 
20 A 	B 	C 	D 

MULTIPLE CHOICE RESPONSE SHEET
FOR LESSON III, PAGE 2

MULTIPLE RESPONSE SHEET SERIES C, page 2

C2

21 A		B		C		D	
22 A		B		C		D	
23 A		B		C		D	
24 A		B		C		D	
25 A		B		C		D	
26 A		B		C		D	
27 A		B		C		D	
28 A		B		C		D	
29 A		B		C		D	
30 A		B		C		D	

MULTIPLE CHOICE RESPONSE SHEET
FOR LESSON III, PAGE 2 (Continued)

31	A	B	C	D
32	A	B	C	D
33	A	B	C	D
34	A	B	C	D
35	A	B	C	D
36	A	B	C	D
37	A	B	C	D
38	A	B	C	D
39	A	B	C	D
40	A	B	C	D

MULTIPLE CHOICE RESPONSE SHEET
FOR LESSON IV, PAGE 1

MARK ALL RESPONSES ON OTHER SHEET, MULTIPLE CHOICE D page 1, D:

1 A	B	C	D
2 A	B	C	D
3 A	B	C	D
4 A	B	C	D
5 A	B	C	D
6 A	B	C	D
7 A	B	C	D
8 A	B	C	D
9 A	B	C	D
10 A	B	C	D

MULTIPLE CHOICE RESPONSE SHEET
FOR LESSON IV, PAGE 1 (Continued)

11 A		B		C		D	
12 A		B		C		D	
13 A		B		C		D	
14 A		B		C		D	
15 A		B		C		D	
16 A		B		C		D	
17 A		B		C		D	
18 A		B		C		D	
19 A		B		C		D	
20 A		B		C		D	

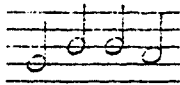
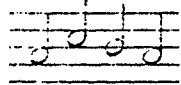
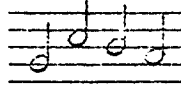
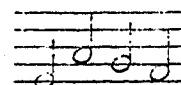
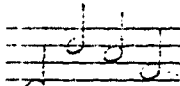
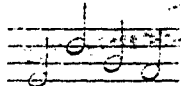
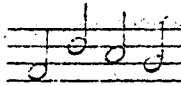
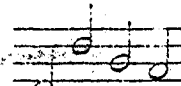
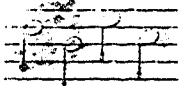
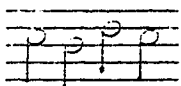
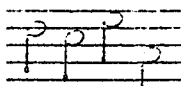
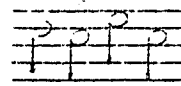
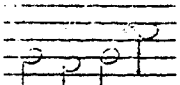
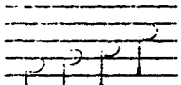
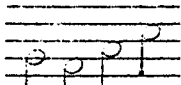
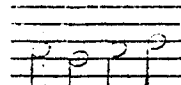
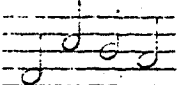
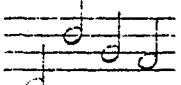
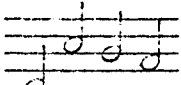
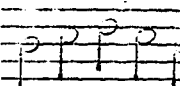
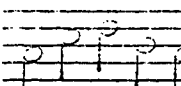
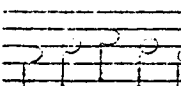
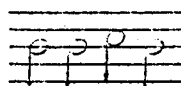
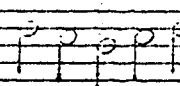
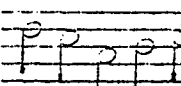
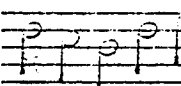
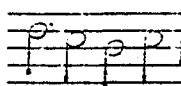
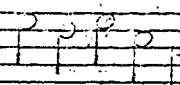
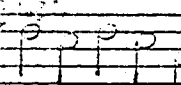
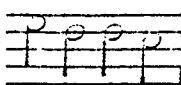
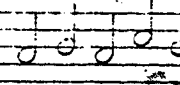
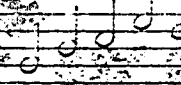
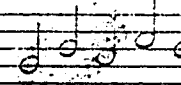
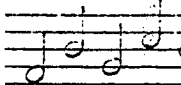
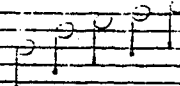
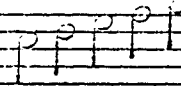
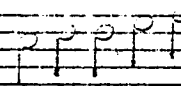
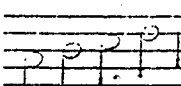
MULTIPLE CHOICE RESPONSE SHEET FOR
LESSON IV, PAGE 2

MULTIPLE RESPONSE SHEET SERIES D page 2

D2

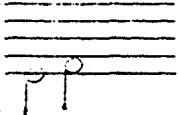
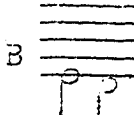
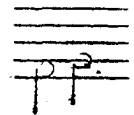
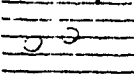
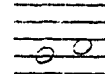
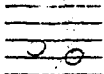
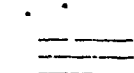
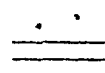
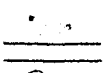
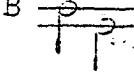
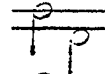
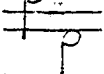
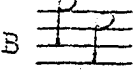
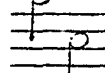
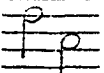
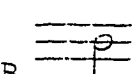
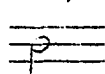
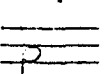
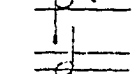
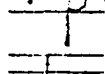
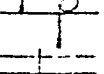
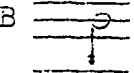
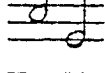
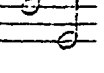
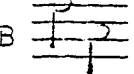
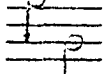
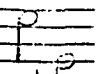
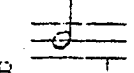
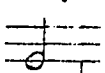
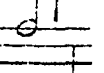
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22 A		B		C		D	
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26 A		B		C		D	
27 A		B		C		D	
28 A		B		C		D	
29 A		B		C		D	
30 A		B		C		D	

MULTIPLE CHOICE RESPONSE SHEET
FOR LESSON IV, PAGE 2 (Continued)

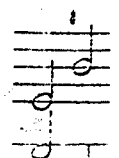
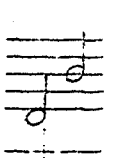
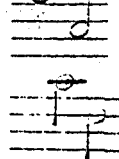
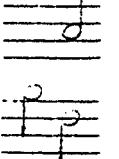
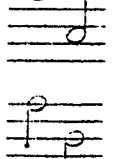
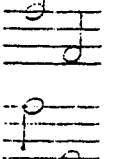
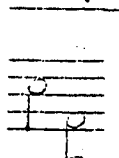
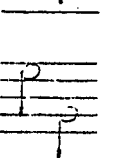
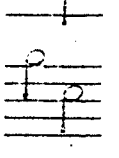
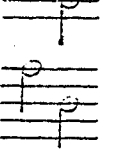
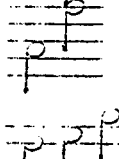
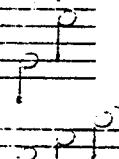
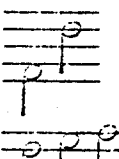
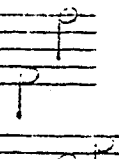
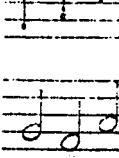
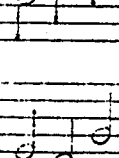
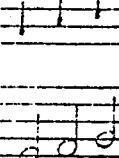
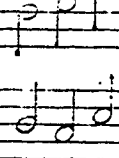
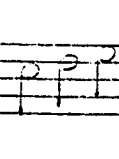
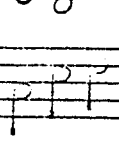
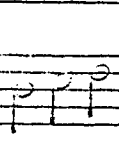
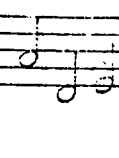
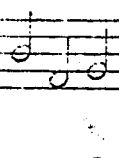
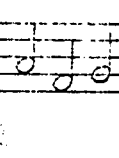
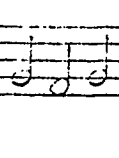
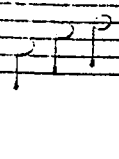
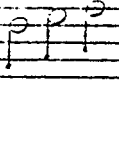
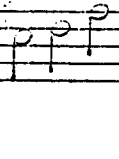
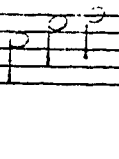
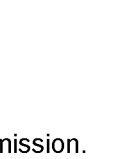
31 A		B		C		D	
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33 A		B		C		D	
34 A		B		C		D	
35 A		B		C		D	
36 A		B		C		D	
37 A		B		C		D	
38 A		B		C		D	
39 A		B		C		D	
40 A		B		C		D	

MULTIPLE CHOICE RESPONSE SHEET
FOR LESSON V, PAGE 1

Mark ALL RESPONSES ON THE OTHER SHEET. SERIES E, page 1

1 A 	B 	C 	D 
2 A 	B 	C 	D 
3 A 	B 	C 	D 
4 A 	B 	C 	D 
5 A 	B 	C 	D 
6 A 	B 	C 	D 
7A 	B 	C 	D 
8 A 	B 	C 	D 
9 A 	B 	C 	D 
10 A 	B 	C 	D 

MULTIPLE CHOICE RESPONSE SHEET
FOR LESSON V, PAGE 1 (Continued)

11 A		B		C		D	
12 A		B		C		D	
13 A		B		C		D	
14 A		B		C		D	
15 A		B		C		D	
16 A		B		C		D	
17 A		B		C		D	
18 A		B		C		D	
19 A		B		C		D	
20 A		B		C		D	

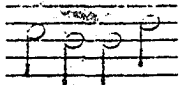
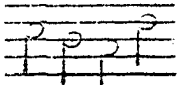
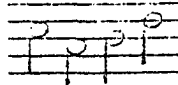
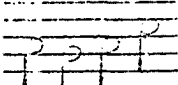
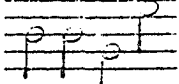
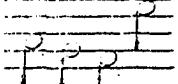
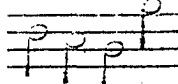
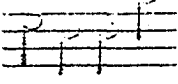
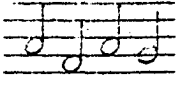
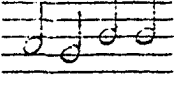
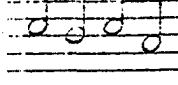
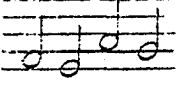
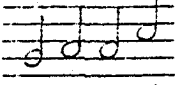
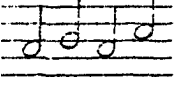
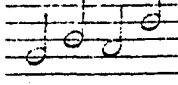
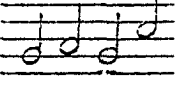
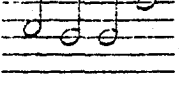
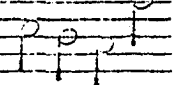
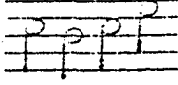
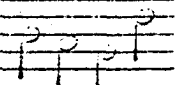
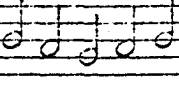
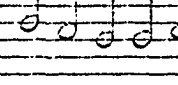
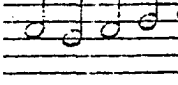
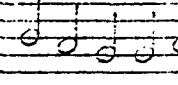
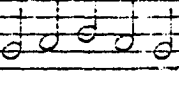
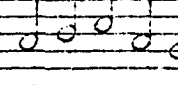
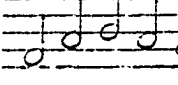
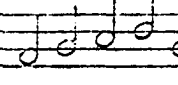
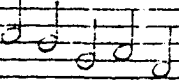
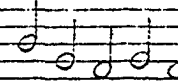
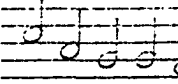
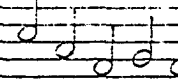
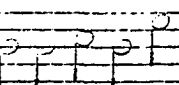
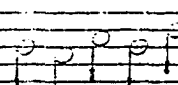
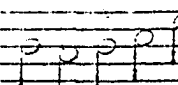
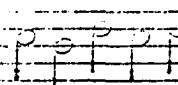
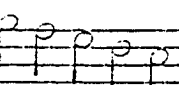
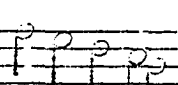
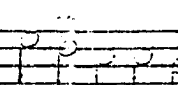
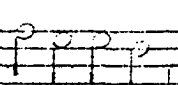
MULTIPLE CHOICE RESPONSE SHEET
FOR LESSON V, PAGE 2

SERIES E page 2

E2

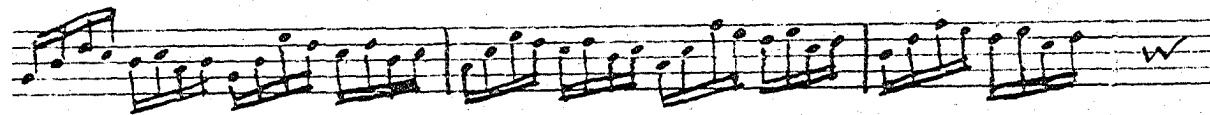
21 A	B	C	D
22 A	B	C	D
23 A	B	C	D
24 A	B	C	D
25 A	B	C	D
26 A	B	C	D
27 A	B	C	D
28 A	B	C	D
29 A	B	C	D
30 A	B	C	D

MULTIPLE CHOICE RESPONSE SHEET
FOR LESSON V, PAGE 2 (Continued)

31L A		B		C		D	
32 A		B		C		D	
33 A		B		C		D	
34 A		B		C		D	
35 A		B		C		D	
36 A		B		C		D	
37 A		B		C		D	
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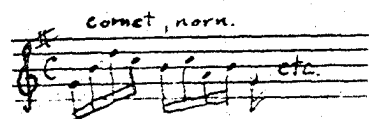
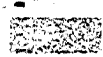
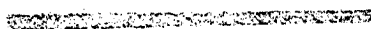
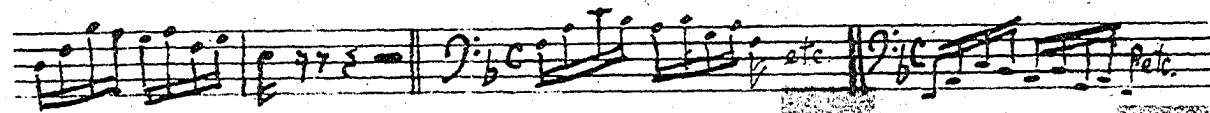
INITIAL AND FINAL SIGHT READING PASSAGES FOR INSTRUMENTAL PLAYERS

violin, flute, oboe, clarinet, saxophone.

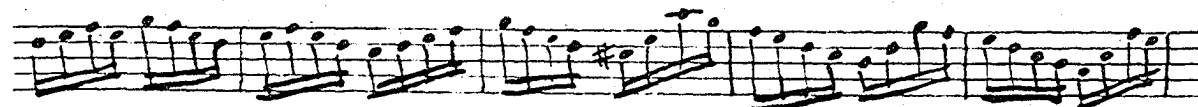
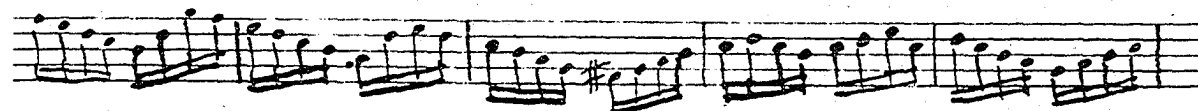
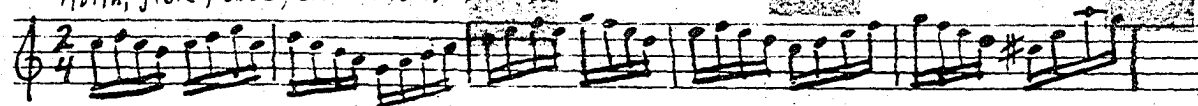


Violoncello, bassoon, trombone, baritone.

Basses.

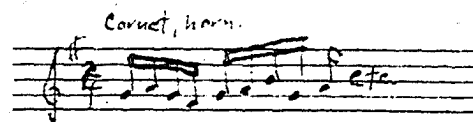
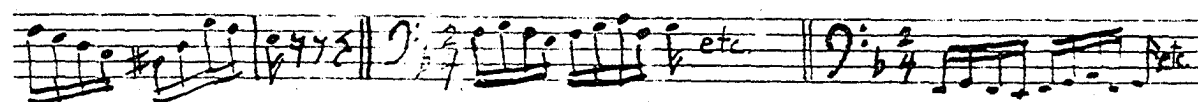


violin, flute, oboe, clarinet, saxophone.



Violoncello, bassoon, trombone, baritone.

Basses.



2