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WORK FOR RESEARCH IN THE DEVELOP-
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The Ohio State University, Ph.D., 1964
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1965
A STUDY OF MUSIC READING:  
GROUNDWORK FOR RESEARCH IN THE DEVELOPMENT 
OF TRAINING PROGRAMS 

DISSERTATION 

Presented in Partial Fulfillment of the Requirements for 
the Degree Doctor of Philosophy in the Graduate 
School of The Ohio State University 

By 

Robert Roscoe Bargar, B.M., A.M. 

*** *** *** 

The Ohio State University 
1964 

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I. INTRODUCTION

The purpose of this study is to establish a basis for research in the development of programs for the training of musicians in music reading skills. Numerous monographs and journal articles have been written on the problems of music reading. Several studies have employed training and testing techniques that involve the presentation of visual patterns for controlled periods of time. The results of these studies indicate that training methods based upon such techniques can be developed successfully into programs for training musicians in music reading skills. Utilizing one of these techniques, the present author conducted an investigation involving three classes of freshman music theory students at The Ohio State University School of Music. In the following study the author develops a logical framework of thought concerning the nature of music reading behavior in individuals, and presents the results of his investigation which demonstrate that visual recognition skills are important to music students.

The study is presented as follows: Chapter II contains a review of experimental studies in music reading. Chapter III is devoted to the identification of types of reading tasks found in music reading activities. Chapter IV contains an analysis of the sequences of events occurring in various music reading tasks. Chapter V contains a listing and brief definition of the types of responses occurring in various music reading tasks. Chapter VI contains a description of the content
and procedures involved in the testing program conducted by the author. Chapter VII is devoted to a presentation of data obtained through the investigation. Chapter VIII contains a summary of the study and a presentation of conclusions and recommendations.
II. REVIEW OF RELATED RESEARCH

The present chapter is devoted to a review of research on music reading. Before beginning the discussion of individual studies, it is important to define several terms which appear in a number of the studies.

**Fixation pause:** The fixation pause in reading has been defined as a momentary pause in the movements of the eyes during which the eyes are at rest and fixated upon a given area of the visual field. It is during the fixation pause that perception is said to occur (Tinker, 1938, 1951; Jacobsen, 1941; Weaver, 1930, 1943; Yarbus, 1954; Cobb and Moss, 1962; Riggs, 1964).

**Span of recognition:** The span of recognition has been defined as the amount of material, i.e. the number of visual stimulus elements, that can be perceived during a single fixation of the eyes (Gray, 1922; Weaver, 1930, 1943; Bean, 1938; Renshaw, 1943, 1945). "Reading span" and "span of perception" are two variant forms of the term employed by authors whose studies are reviewed in this chapter. These terms have the same meaning as "span of recognition."

**Tachistoscope:** A tachistoscope is an instrument for presenting visual images to individuals for controlled periods of time, which may range from one-thousandth of a second (.001 seconds) or less to any desired number of seconds or minutes. Tachistoscopes of various types have been used for many years, both for the investigation of visual processes and for the training of individuals in the development of visual skills.
Studies conducted prior to 1930

Weaver (1930) reviewed studies on the subject of music reading written between 1396 and 1930. Many of these studies contained suggestions and hints for the student to use in developing reading skills. A few of these studies discussed the relevance of research in language reading to music reading, but no attempts were made by any of the authors to experimentally apply the results of this research to the task of developing a program for training musicians in music reading skills.

Studies conducted since 1930

Weaver (1930) conducted a series of experiments in which he investigated "the reading span for music and the nature of eye movements during music reading." Reading span was investigated by means of a tachistoscopic device. Music note patterns were presented to the subjects at an exposure time of one-tenth of a second (.1 seconds). The subjects responded both by writing patterns and by playing patterns on the piano. The subjects consisted of college students and professional musicians assigned to four groups that differed according to the level of reading and performing skill of the individuals. Weaver found that reading span varies with the type of note patterns presented, with the amount of training reported by the individuals, and with the method of recording the response; proficiency in perceiving and performing tachistoscopically presented patterns "varies directly with the amount of training;" the mean number of notes reproduced per exposure was higher for playing patterns than for writing patterns; a low correlation exists between the ability to write and play patterns; a given individual may vary considerably in his ability to reproduce different
types of note patterns; a low correlation exists between the reproducing of horizontal and vertical patterns; notes grouped into patterns are easier to perceive than notes presented in random positions.

Weaver studied eye movements by means of modified photographic equipment. The subjects consisted of college students and professional musicians of advanced skill in sight reading and performing music patterns. Weaver found that the average duration of the reading pause is slightly longer for the reading of musical material than for other types of reading; a high correlation exists between total reading time and the average duration of the reading pause; a low correlation exists between total reading time and the number of pauses per subject; the organization of eye movements varies greatly with the type of musical material; there is a low correlation between the number of notes that can be seen per pause as determined by tachistoscopic exposures and the average number of notes per pause that can be seen while reading music; regressive movements of the eyes take place during the reading of music, but not always for the purpose of refixation on previously occurring material; refixations were observed to occur without accompanying movements of the eyes.

Buegel (1934) conducted a study whose chief purpose was to search for evidence which will support the view that there exists a psychological relationship between the problems of language reading and the reading of piano scores. The subjects used in the study varied widely in age and music reading skill. Music patterns of various types and degrees of complexity were presented to the subjects by means of a tachistoscopic device. The subjects responded by playing the patterns on the piano. Buegel found that the size of the span of recognition varies with the reading skill of
the individual; the subjects organized single notes into larger perceptual units while reading; many subjects do not see the details of items but fill in response patterns based upon visual cues received from parts of the exercise patterns; familiarity with the material influences the span of recognition; span of recognition is not necessarily an indicator of performance ability.

Ortmann (1934) tested a group of music students in the perception of chordal patterns which were presented by means of a tachistoscopic device. Ortmann found the following factors to be important in the perception of chordal patterns: the number of notes per pattern, the vertical distance covered by the notes, the visual form of the note patterns; the type of chordal units being presented, the visual structure of the staff in terms of lines and spaces, and the mental set of the perceiver with respect to the kind and complexity of patterns expected. Ortmann also found that individuals skilled at visually perceiving note patterns are not always skilled at sight reading and reproducing musical compositions on instruments. He concluded that "sight reading is a complex process which does not depend upon the perception of single note elements... On the other hand, the principles underlying the reading of the [visual] stimuli... probably function in the reading of complex stimuli as well."

Ortmann (1937) investigated factors which influence difficulties in note reading. Music patterns were presented to subjects by means of a tachistoscopic device. Ortmann concluded: "The test shows... that for the normal pupil, difficulties in note reading are not due to actual eye difficulties, but result from inability to group the distribution of the notes into larger perceptual units. Preliminary training [tachistoscopic
training which we have introduced to overcome this difficulty has already resulted in a marked improvement." Ortmann listed the following factors which affect the individual's ability to group notes into perceptual units: "the number of notes in the visual field, the area covered by the distribution of these notes, the number of linear dimensions involved, the complexity or symmetry of the note pattern, the meaning of the note group from either a harmonic or melodic standpoint - or both."

Bean (1939) investigated "the complexity of musical patterns that can be perceived with one fixation of the eyes by individuals with various degrees of musical training and experience, and the effects of tachistoscopic practice on the span of perception of these patterns." A tachistoscopic device mounted on a piano was used for all phases of the study. The subjects consisted of music students and professional musicians of varying degrees of ability at sight reading and performing music. Concerning the diagnostic experiment, Bean stated that "efficient readers are able to grasp groups of three, four, or more notes at a glance. Slow, stumbling readers on the other hand are seldom able to grasp more than one or two notes at a time." Concerning the training, Bean concluded that "practice with the tachistoscope demonstrated that part readers [those who read note by note] may become pattern readers if their response to notes is sufficiently automatized."

King (1939) compared groups of good and poor readers on the basis of a series of visual and auditory tests. King lists the following tests: "test of hearing acuity, musical hearing, auditory perception, professional optometric examinations, telebinocular tests of visual sensation, tests of eyedness and handedness, tests of visual perception, and a supplementary test
of music symbol knowledge." King found differences between the two groups only on the tests of musical hearing involving music memory, feeling for tonal movement, pitch discrimination, time discrimination, and rhythmic imagery. King concluded that "ability in these aspects of musical hearing seems to be directly related to skill in reading music."

Wheelwright (1939) investigated "the effect of spacing music symbols in consistent relationships to time values upon perception and sight-reading performance at the piano." As a result of his study, Wheelwright concluded that "both for visual perception and sight reading performance at the piano, music spaced in one to one relationship to time values offers psychological advantages to the reader not now provided by music that is traditionally spaced."

Jacobsen (1941) investigated eye movements in reading music. He was able to classify his subjects as immature, average, or mature readers on the basis of the following findings: the reading behavior of mature readers is characterized by fewer reading pauses, by fewer regressive movements and by greater speed in reading; the reading behavior of immature readers is characterized by many fixation pauses, by many regressive movements and by a longer time to complete a given reading task. The span of recognition as measured by the techniques in the study was found to be 2.5 notes per pause for mature readers and only .41 notes per pause for immature readers. Jacobsen concludes that "this condition [differences in recognition span of mature and immature readers] indicates the need of drill in recognition for immature readers. Such drill could be carried on by the use of flash cards [tachistoscopic training]."
Weaver (1943) investigated ocular behavior in music reading. The subjects consisted of fifteen musicians who were proficient in sight reading. Weaver found that the average span of perception for the subjects varies between three and five notes for different types of note patterns; the average number of notes reproduced by subjects per reading pause varies between one and two; the average duration of the reading pause varies between .27 and .53 seconds; a word and a musical note on the staff are equivalent units from the standpoint of the average number read per pause. Weaver concluded that the reading of piano music is a complex perceptual process involving pitch, temporal, dynamic and harmonic relationships of notes perceived as parts of rhythmic and melodic sequences and phrases; individuals performed differently depending upon the particular material being perceived.

Van Nuys and Weaver (1943) investigated memory span and visual pause in reading rhythms and melodic patterns of various types and levels of difficulty. The authors define memory span as "the average number of notes executed correctly by an individual after the presentation of a phrase." The subjects consisted of a group of twelve college music students. The authors found that the average number of notes performed per reading pause varied from .4 to 1.4 depending upon the material; the average duration of the reading pause varies from .26 to .34 seconds; as the complexity of the note patterns increases, the average memory span of the subjects decreases and the average duration of the pause for the subject increases; regression movements occur more often for melodies than for rhythms. Two of the authors' more important conclusions were: 'Melodic factors constitute the limiting conditions for memory span whenever the melody is not extremely simple. An increase in memory span depends largely upon improvement in
ability to apprehend pitch patterns as stable melodic segments of a composition. Rhythmic factors constitute the limiting conditions for rate of reading or average pause duration whenever the rhythm is not extremely simple. This implies that increase in rate of reading depends upon improvement in ability to grasp rhythmic figures."

Stokes (1943) conducted an experimental tachistoscopic training program with groups of seventh and eighth grade students. The exercise materials were designed to emphasize span of recognition and utilized various geometric and word patterns as well as melodic note patterns. The melodic note patterns contained only half-notes and were designed according to contour of line and length of pattern. The patterns were presented tachistoscopically and the subjects were requested to compare each flashed pattern with a same or different pattern played on the piano. Responses to the patterns were written and consisted of circling S (same) or D (different) on a response form. Stokes found that while the experimental group did show improvement on tests of the training, there was no improvement noted in tests involving the sight reading and performing of music. On the basis of these results Stokes questioned the usefulness of the tachistoscopic technique as a training technique in music reading.

Smith (1947) investigated auditory imagery as a factor in music reading. The subjects used were high school students divided into three groups classified as advanced, intermediate and inexperienced music students. The data were collected by means of the Knuth Achievement Tests in Music, Forms A and B (Knuth, 1936) and "the student's subjective measurement or evaluation of the clearness of his own auditory imagery while observing the written notes." Smith concluded that "the general trend of evidence seems
to point out that auditory imagery is present in the music reading complex; its development progresses simultaneously with the development of skills in music reading; music reading and auditory perception of musical sounds are interrelated and interactive."

Wheeler and Wheeler (1951) investigated the relationships between music reading and language reading by means of the Knuth Achievement Tests in Music (Knuth, 1936) and the Progressive Reading Tests, Form A (Tiegs and Clark, 1943). The authors conclude that "there is a low positive correlation between music reading and language reading," and that "the ability to read language is more closely related to intelligence than is the ability to read music."

Christ (1953) conducted an experimental rhythmic training program utilizing tachistoscopically presented rhythmic patterns to which college freshman music theory students responded by reading and tapping in tempo with a metronome. Differences between test-retest scores were significant at the .002 level. Christ concluded that the training was "a quick and efficient means of training rhythm," and that "training to increase the rate and span of perception of rhythmic symbols, combined with practice in tapping patterns to a constant metronome beat results in increased efficiency in the performance of a continuous succession of such symbols."

Thompson (1953) tested four groups of violinists and clarinetists of various ages and levels of attained skill in music in their ability to sight read and perform music. The test consisted of graded musical selections designed to emphasize four aspects of musical notation and performance: rhythm, accidentals, keys, and pitch. The following conclusions were among those reached by Thompson: the playing of rhythm was the greatest source
of difficulty; accidentals offer considerable difficulty particularly during the first few years of study for violinists and clarinetists; difficulty with key signatures increases directly with the order in which sharps and flats are introduced; violinists and clarinetists acquire proficiency in pitch prior to proficiency in rhythm, accidentals and keys; relative difficulty in playing rhythm, pitch, accidentals and keys varies little among levels of performing ability; violinists and clarinetists differ only slightly in terms of error patterns made on the test.

Peitersen (1954) investigated the effects of music reading training with notation spaced mathematically according to the rhythmic values of notes on the reading of commercially printed music. The subjects consisted of experimental and control groups of junior high school band students. Peitersen concluded that spaced notation shows significant advantages over non-spaced notation in the immediate perception of rhythmic figures, but that reading training with spaced notation does not have any more significant effect on the reading of commercially printed music than reading training with commercially printed music.

Skornika (1957) investigated the effects of special rhythmic training involving counting and tapping of rhythm in relation to sounded musical patterns upon skills at sight reading among elementary school children. Differences were found between experimental and control groups on the post-tests. Skornika concluded that controlled emphasis of time and rhythm in training can aid in the development of reading skill.

Luce (1958) conducted an investigation to "determine the relationship between instrumental music students' abilities to sight-read music and to reproduce immediately music which they hear." The subjects consisted of
13 instrumental music students in grades nine, ten and eleven. Information gathered concerning the students included: instrument played, kinds of instruction received on the instrument played, the number of hours of instruction received, leadership status in music groups, age, I. Q., and mental age. Sight-reading and ear-playing tests created by the author were administered to all subjects on their respective instruments. Luce found that a significant relationship exists between sight reading and ear-playing for all subjects; I. Q., mental age and leadership status have a high relationship to sight-reading and ear-playing; instrumental group hours, school instrumental groups hours and total private study hours are highly related to sight-reading and ear-playing. The author concluded that ear-playing skills may be as important as sight-reading skills in the development of musical skills in individuals.

Barnes (1960) investigated "(1) the effect of group drill in in sight singing certain intervals upon the ability of the individual to sight sing these intervals, and (2) the correlation between the ability to sing intervals and the ability to sight sing melodies composed of these intervals." The subjects consisted of two groups of freshman music theory students equated on the basis of the American Council on Education Psychological Examination and the Aliferis Music Test, and the interval and melodic sight singing tests constructed by the author. The training of the experimental group consisted of tachistoscopically presented intervals to which the subjects responded by singing. Barnes found differences between post-test gains by the experimental and control groups both on the test involving the sight-singing of intervals, and on the test involving the sight-singing of melodies. A high correlation was found between the sight-singing of
intervals and melodies containing those intervals. Barnes concluded that
the tachistoscopic training was superior to the conventional training given
to the control group.

Petzold (1960) investigated the following factors which he listed
as being essential to music reading: "(1) the auditory perception of
musical sounds, (2) the visual perception of musical symbols, and (3) the
integrative, internalized processes through which the individual organizes
previous auditory and visual perceptions of given stimuli in order to react
to these same, or similar, stimuli as they appear in new learning situations."
These factors were investigated primarily with respect to those musical
symbols which indicate pitch. These symbols were studied in the form of
tonal patterns.

The subjects used in the study consisted of groups of average and
gifted fourth, fifth, and sixth grade students. The first phase of the study
consisted of an analysis of childrens' songs in order to identify tonal
patterns according to their frequency of appearance in songs. The tonal
patterns to be used in the learning situations and tests involved in the
study were selected from the results of this analysis. During Phase I
of the testing procedure the subjects were presented with a series of tonal
patterns which they were asked to sing. After each pattern had been sung it
was again presented to the students along with an aural representation of the
pattern. The student could then compare his performance of the pattern with
a correct sounding of the visual pattern. During Phase II of the testing
program, the subjects were asked to learn (1) five tonal configurations and
then a short song constructed from the configurations, and (2) a song
constructed from the five tonal configurations and then the configurations.
Petzold found that there is no significant difference between boys and girls in terms of the ability to read music; subjects experienced considerable difficulty in reading tonal configurations which commonly appear in the songs they sing; the common reading errors revealed a general tendency to respond to the outward shape of the configuration, or to substitute a similar, more familiar one for the one being read; the subjects performed at a much higher level on the aural part of the test than on the visual part; [sight singing] the song was a more complex task than sight singing the individual tonal configurations, regardless of the sequence of tasks; the scores of subjects reporting instrumental training were not significantly higher than the scores of individuals who did not have such training; the identification of gifted and average subjects on the basis of teacher's ratings and the Kwalwasser [1930] test does not result in a high level of reliability.

Petzold concluded that accurate reading of musical notation is more apt to result when greater emphasis is placed upon understanding the significance [function] of the notation rather than upon mere 'imitation' [rote learning] of musical materials; the musically superior child needs to be given more opportunities to develop music reading competence; the data did not clearly establish that one sequence of tasks is superior to the other in developing music reading competence; if music reading is approached by means of the configuration, greater emphasis needs to be placed upon helping children recognize the shape and design of such configurations; instrumental instruction did not seem to be a factor in the music reading of either the average or gifted children in the study; the relationship between auditory and visual perception needs to be more clearly established.

Hammer (1961) conducted an experimental study "to determine the effect of tachistoscopic training on the development of melodic sight singing ability." The subjects consisted of two fourth grade classes from the same school. These classes did not differ significantly in I. Q., pitch discrimination, tonal memory, chronological age, and melodic sight singing ability. The exercises consisted of commonly used tonal patterns as compiled by Petzold (1960). The training followed a procedure in which each tonal pattern used was viewed and sung by the class and then flashed
tachistoscopically several times to the class until all students had recognized the pattern. Both the experimental and control groups showed improvement; however, the improvement evidenced by the experimental group was greater than that evidenced by the control group. Hammer concluded that "Tachistoscopic training was significantly more effective than conventional training in developing melodic sight singing ability at the fourth-grade level provided that: (a) an effective method was employed in teaching the subject; (b) proper tachistoscopic materials and procedures were used with the method; and (c) the students had some prior experience in sight singing."

Wiley (1962) conducted an experiment to "ascertain the relative effectiveness of tachistoscopic and conventional techniques in the development of the ability to sight read rhythm patterns in music." The subjects consisted of two fifth-grade classes. Both classes received the same training materials, but the experimental class received tachistoscopic training with the rhythmic patterns along with the more conventional training. The results indicate that both groups improved on the post-tests as a result of the training. However, the experimental group receiving tachistoscopic training did not show greater improvement than the control group receiving only the conventional training.

Houston (1963) investigated "the effect of the use of the reading accelerator on the development of keyboard sight reading ability." The subjects consisted of twenty organ students who received ten minutes of training each week for the period of a semester. The training consisted of selected short musical compositions of varying difficulty played at rigidly controlled tempos. The tempos and levels of difficulty of the selections were increased during the course of the semester. Individuals in the
experimental group used a reading accelerator. Those in the control group were also restricted to a time limit for the performance of each exercise. Houston found that each group improved in sight reading skill, but that no difference in improvement existed between the two groups. The author concluded that the reading accelerator was no more effective in improving reading skill of individuals than the conventional teaching methods employed.

The studies which have been reviewed above are quite diverse in objectives, in procedures, instrumentation, and subjects. Those studies which utilize the tachistoscope are of greatest importance to the present investigation. The major results of these studies will be summarized and some limitations noted.

Studies involving the tachistoscope may be divided into two groups:

1. Those which use a tachistoscopic device as a diagnostic testing instrument;
2. Those which use a tachistoscopic device as a training instrument.

The tachistoscopic studies that have been diagnostic in nature are those by Weaver, Ortmann, Buegel, and Bean. The following results can be summarized from these studies:

1. Individuals perceive written music by perceptually grouping individual notational symbols into patterns. (Weaver, Ortmann, Buegel, Bean).
2. The term, "span of recognition" represents an important concept in understanding the nature music reading. (Weaver, Ortmann, Buegel, Bean).
3. Span of recognition and perceptual grouping are interrelated and are affected by such factors as
   a. the number of musical symbols in the visual field, (Ortmann, Buegel),
b. the relative positions and complexity of distribution of musical symbols in the visual field, (Weaver, Ortman, Buegel),

c. the size of the area covered by the distribution of notes in the visual field, (Ortmann),

d. the 'meaning' of the notational symbols in terms of musical function or pre-learned patterns, (Ortmann, Buegel),

e. the physical structure of the staff in terms of lines and spaces, (Ortmann),

f. the amount of training of the individual, (Weaver, Buegel, Bean),

g. the mental set or expectancy of the perceiver with respect to the kind and complexity of materials to be perceived, (Ortmann),

h. the ability of individuals to group notes into perceptual units, (Ortmann).

4. A given individual may vary considerably with respect to skill in perceiving and reproducing note patterns of different types (Weaver, Buegel).

5. Difficulties in the visual perception of written music result from the individual's lack of skill in grouping music symbols into perceptual units (Ortmann, Bean).

6. Skill in the visual perception of note patterns is only one of the factors involved in music reading. Individuals skilled in visually perceiving note patterns are not necessarily skilled at sight reading and performing music (Ortmann, Buegel).

The tachistoscopic studies that have been concerned with training programs are those by Bean, Stokes, Christ, Barnes, Hammer and Wiley. The results obtained by Stokes and Wiley are inconclusive. However, the results obtained by Bean, Christ, Barnes and Hammer indicate that a tachistoscopic technique can be applied successfully in a program for training musicians in music reading skills.
A closer review of the tachistoscopic training studies listed above indicates certain limitations which must be noted.

1. The most recent tachistoscopic training studies have been concerned only with certain aspects of musical notation and certain types of note patterns: rhythm—Christ and Wiley; intervals—Barnes; melodic patterns—Sjöknes and Hammer. The earlier study by Bean is the only one in which complex music patterns, as found in musical compositions, were used as training materials. Most music reading does involve the perception of written music which is complex in texture. The direct application of the results of these studies in the further development of training programs involving the tachistoscope is therefore limited by the specific notational elements and types of patterns involved in a given study.

2. A diversity of training procedures, tachistoscopic instruments, exercise materials and subjects was employed in the tachistoscopic training studies under consideration. The data available in these studies cannot be evaluated to determine whether or not one training procedure, one type of tachistoscopic instrument, or one set of exercise materials is clearly superior for training musicians in music reading skills.

On the basis of these limitations it was concluded that further exploratory work needed to be undertaken in developing the tachistoscopic technique as a method for training musicians in music reading skills.
III. MUSIC READING TASKS

The purpose of the present chapter is to identify the types of music reading tasks in which musicians must become skilled. The discussion is presented in the following manner:

1. Various roles which can be observed in the training and professional life of musicians are listed.
2. These roles are described with respect to the music reading activities which they encompass.
3. The specific music reading tasks occurring in these musical activities are identified.
4. A summary of individual music reading tasks is compiled from listings of tasks identified in the various music reading activities.

Training and professional roles in the field of music

An analysis of music reading tasks may begin with a consideration of the activities of musicians. These activities can be brought to focus in terms of the professional roles which musicians play in the pursuit of their interests and livelihood. The point of departure for the present discussion is what may be considered the elementary social context of musical activity. This elementary social context is illustrated by Figure 1.
Fig. 1.--The elementary social context of musical activity

A. The written music  C. The instrument
B. The musician  D. The listener

Two essential roles are illustrated in Figure 1: the musician as performer and the listener. From this elementary social context we may identify other important roles. Figure 2 introduces the musician as conductor.

Fig. 2.--E. The conductor
Figure 3 introduces three additional roles essential to the sustenance of the elementary social context suggested in Figure 1: the musician as student, the musician as teacher, and the musician as composer.

![Diagram](image)

Fig. 3.—F. The student, G. The teacher, H. The composer

From these figures can be listed six different roles:

1. Creating
2. Performing
3. Conducting
4. Listening
5. Learning
6. Teaching

A complete outline of the various occupational roles related to the field of music would include more than the above. Such occupational activities as marketing, managing, instrument construction, etc., could be added. However, it is towards the professional pursuit of the six roles listed above that institutions of higher learning primarily direct their educational programs in music. The present study is concerned with the development of training techniques for use in such institutions; therefore, the discussion will be concerned with these roles in their professional aspects.
Music reading activities occurring in various training and professional roles

The various roles indicated above can be defined and the music reading activities involved in these roles listed.

1. Creating

Creating is the making of patterns to be translated into sound (performed) as music. Creating can occur either prior to a performing act (composing), or can occur as a performing act (improvisation).

Composers use music reading skills

a. to notate what they have created;

b. to study and review what they have created (written) both for revision and as a basis for further creating.

2. Performing

Performing is the translating of created patterns into sound.

Performing exhibits several characteristic dimensions:

a. Performing may be a translation into sound of

   (1) written patterns,
   (2) memorized patterns,
   (3) improvised patterns.

b. Performing is engaged in by

   (1) individuals,
   (2) groups.

c. Performing is employed by

   (1) performers while performing,
   (2) composers while creating,
(3) teachers while teaching.
(4) students while learning.

Performers use music reading skills

a. to develop knowledge and skills appropriate to a given performing medium;

b. to evaluate and select music to be used in a given performing situation;

c. to learn specific compositions for performance, including the development of specific response habits necessary to the performing of a given composition;

d. to perform specific compositions from written music symbols.

3. Conducting

Conducting is the leading (directing) of others in the translating of created patterns into sound. The situations in which conducting occurs may vary in terms of

a. group size;

b. the type of instruments in the group;

c. the musical/social function of the performance.

Conductors use music reading skills

a. to evaluate and select music to be conducted;

b. to learn specific compositions to be conducted in performance;

c. to direct the rehearsal of performing groups in the preparation of specific compositions for performance;

d. to conduct specific compositions in performance.

4. Listening

Listening is the aural perceiving of created patterns when translated into sound (performed). Individuals aurally perceive music
patterns while
a. composing,
b. performing,
c. conducting,
d. listening,
e. studying,
f. teaching.

Listeners often use music reading skills to follow and study music as it is being performed. This is particularly true of professional students of music.

5. Learning

Learning in the field of music is the developing of knowledge and skills through which individuals participate in musical activities.

Skills developed by individuals through learning include
a. creating skills,
b. performing skills,
c. conducting skills,
d. listening skills,
e. learning skills,
f. teaching skills.

Students use music reading skills
a. to study the structure of musical compositions;
b. to learn information about music;
c. to develop skills utilized in other musical tasks such as sight singing, keyboard harmony and part writing;
d. to learn specific compositions on their individual instruments, including the development of specific response habits necessary to the learning of a given composition.

6. Teaching

Teaching in the field of music is the instructing of others in the development of knowledge and skills necessary to participation in musical activities. Skills developed by students while being instructed include

a. creating skills,
b. performing skills,
c. listening skills,
d. conducting skills,
e. learning skills,
f. teaching skills.

Teachers use music reading skills

a. to evaluate and select music for use in instruction;
b. to analyze and study (learn) music for teaching;
c. to prepare music materials for teaching;
d. to play and demonstrate music while teaching;
e. to follow and evaluate students' performances and recitations.

The identification of music reading tasks occurring within each music reading activity

The specific music reading tasks found in the music reading activities listed above can be identified.
1. Creating

a. Notating created patterns.--In reading and notating (copying) what he has written, a composer may

(1) read and analyze the patterns he is to notate;

(2) read and visually compare the patterns both as he notates them and after he has notated them;

(3) read and auralize the patterns he is to notate.

b. Studying and reviewing created note patterns.--In studying and reviewing the note patterns he has written, a composer may

(1) read and "auralize" what he has written, i.e., he may aurally perceive what he has written without recourse to external sensory excitation;

(2) read and play (perform) what he has written;

(3) read and compare the patterns he has written with their performance by himself or by others;

(4) read and analyze the patterns he has written, i.e., he may read patterns in order to identify musical elements and to define structural relationships;

(5) read and visually compare patterns he has written.

2. Performing

a. Developing knowledge and skills appropriate to a given sounding (performing) medium.--In developing knowledge and skills appropriate to a given sounding (performing) medium, a performer may

(1) read and play exercise patterns on his instrument;

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1English and English (1950) define auralize as follows: "to utilize the auditory sense or auditory content in imagination or thinking; the auditory counterpart of visualize." This meaning shall be applied to the term in this study.
(2) read and compare written patterns with his performance of these patterns;

(3) read and auralize patterns;

(4) read and visually compare patterns.

b. Evaluating and selecting music to be performed.--In evaluating and selecting music to be performed, a performer may

(1) read and play patterns on his instrument;

(2) read and analyze patterns;

(3) read and visually compare the patterns within a given composition with each other, or with patterns in other compositions, i.e., he will read patterns in order to determine, from past experience, what would be easy or difficult, or of particular esthetic value in a given performing situation;

(4) read and auralize patterns.

c. Learning specific compositions.--In learning specific compositions for performance, a performer will develop the specific response habits necessary to the performance of a given composition. In so doing he may

(1) read and play patterns as he develops the motor skills appropriate to the performance of the patterns;

(2) read and compare written patterns with his performance of these patterns;

(3) read and auralize patterns;

(4) read and visually compare patterns.

d. Performing specific compositions.--In performing a specific composition from written note patterns, a performer may

(1) read and play patterns;
(2) read and compare written patterns with his performance of these patterns;

(3) read and auralize what he has read, i.e. he may form a perceptual assumption concerning what the patterns should sound like;

(4) read and visually compare the patterns found in the composition with each other, and with other patterns found in previous compositions, i.e. he will read presently encountered patterns in terms of similar patterns experienced in the same composition and in previously read compositions.

3. Conducting

a. Evaluating and selecting music to be conducted. -- In evaluating and selecting music to be conducted, a conductor may

(1) read and auralize patterns;

(2) read and play patterns (the musical score) at the piano;

(3) read and analyze patterns;

(4) read and compare the written musical score with its performance, i.e. he may follow the score while listening to a recording or to some other production of the music;

(5) read and compare visual patterns within a given composition, or with patterns in other compositions, i.e. he may form judgments concerning difficulty, appropriateness to a given conducting situation, etc. from his previous experience with similar patterns.

b. Learning music to be conducted. -- In learning music to be conducted, a conductor will develop the specific response habits appropriate to the conducting of a given composition. In so doing he may

(1) read and play (perform) or listen to a given composition as he develops the perceptual skills appropriate to conducting the composition;
(2) read and rehearse conducting movements as he develops motor skills appropriate to conducting the composition;

(3) read and auralize patterns;

(4) read and compare patterns visually.

c. Rehearsing specific compositions.—In rehearsing a specific composition to be conducted, a conductor may

(1) read and conduct the rehearsing of the composition;

(2) read and compare written patterns in the musical score with the performance of the patterns by the performing group;

(3) read and visually compare patterns in the given composition being rehearsed;

(4) read and auralize patterns;

(5) read and analyze patterns;

(6) read and play patterns on given instruments.

d. Conducting a composition in performance.—In conducting a composition in performance, a conductor may

(1) read and conduct the performing of the composition;

(2) read and compare written patterns in the musical score with the performance of these patterns by the performing group;

(3) read and visually compare musical patterns in the given composition to be conducted;

(4) read and auralize patterns while conducting;

(5) read and analyze patterns while conducting.

4. Listening

In listening to music, a listener often follows the written score, i.e., he may read and compare written patterns with the performance of these same patterns. This appears to be the only notational reading task required of listeners.
5. Learning

a. **Studying the structure of music.**--In studying the structure of a musical composition, a student may

   (1) read and analyze patterns;
   (2) read and play patterns as he analyzes them;
   (3) read and auralize patterns;
   (4) read and compare patterns visually;
   (5) read and compare written patterns with their performance as produced by himself or by others;
   (6) read and notate patterns.

b. **Learning information about music.**--In learning information about music a student may be involved in all those reading tasks listed in a. above.

c. **Learning other music skills.**--In learning other music skills, such as sight singing, keyboard harmony, part writing, etc., a student may

   (1) read and sing patterns;
   (2) read and play patterns on the piano;
   (3) read and notate patterns;
   (4) read and analyze patterns;
   (5) read and compare patterns visually;
   (6) read and auralize patterns.

d. **Learning specific compositions.**--In learning specific compositions for performance a student will develop the specific response patterns necessary to the learning of a given composition. In so doing he may
(1) read and play patterns as he develops the motor and perceptual skills appropriate to the learning of the patterns;

(2) read and compare written patterns with his performance of these patterns;

(3) read and auralize patterns;

(4) read and compare patterns visually.

6. Teaching

a. Evaluating and selecting music for instruction.--In evaluating and selecting music for instruction, a teacher may

(1) read and play patterns on a given instrument;

(2) read and analyze patterns;

(3) read and visually compare patterns within a composition, or among different compositions;

(4) read and auralize patterns.

b. Analyzing and studying (learning) music for teaching.--In analyzing and studying music for teaching, a teacher may

(1) read and analyze patterns;

(2) read and play patterns;

(3) read and visually compare patterns;

(4) read and auralize patterns;

(5) read and compare written patterns with his performance of these patterns.

c. Preparing music materials for teaching.--In preparing music materials for teaching, a teacher may

(1) read and play patterns on a given instrument;

(2) read and analyze patterns;
(3) read and visually compare patterns within a composition, or among different compositions;

(4) read and auralize patterns;

(5) read and compare written patterns with his performance of those patterns.

d. **Playing and demonstrating music while teaching.**—In playing and demonstrating music while teaching, a teacher may

(1) read and play patterns;

(2) read and auralize patterns;

(3) read and compare written patterns with his performance of these patterns;

(4) read and compare patterns visually.

e. **Evaluating students' performances and recitations.**—In evaluating students' performances and recitations, a teacher compares the students' performances with the written score.

**A summary of individual music reading tasks found in music reading activities**

It is evident from the preceding discussion that there is a considerable duplication of specific reading tasks among various music reading activities. These reading tasks can be summarized as follows:

1. to read and perform patterns;
2. to read and notate patterns;
3. to read and auralize patterns;
4. to read and analyze patterns;
5. to read and compare patterns visually;
6. to read and compare written patterns with their performance.

All of these reading tasks are required of music students.
The music reading tasks occurring in various musical activities have been summarized. The sequences of behavioral events occurring in these reading tasks are detailed in Chapter IV.
IV. THE MUSIC READING CYCLE

The discussion in Chapter III concluded with a summary of music reading tasks. In the present chapter, a consistent pattern of perceptual and response behavior, referred to as the music reading cycle, is identified as being characteristic of all reading tasks. The discussion is presented as follows:

1. The sequence of events occurring within each music reading task is detailed.

2. A pattern of perceptual and response behavior common to all sequences of events is identified and described.

A detailing of events occurring in each music reading task

The reading tasks listed at the end of Chapter III can be detailed in terms of the sequences of individual perceptual and response events that can be identified within each task. These sequences of events are illustrated and outlined on the following pages.
1. Note Patterns Read and Performed

Fig. 4.—The performing of written note patterns

A. Visual stimulus source.

D. Reception of visual stimuli.

C. Perception and transformation of stimulus patterns into appropriate response patterns.

D. Tactual/kinesthetic-motor responses that result in the producing of sound patterns.

D. and E. Reception of tactual/kinesthetic and aural stimuli produced by the response patterns.

C. Perception and transformation of tactual/kinesthetic and aural stimuli patterns into appropriate judgments concerning the accuracy of instrumental responses to the visual stimuli. This involves the following:

1) Aural-visual comparison--the student is required to relate what he hears as his response to what he remembers having seen as the visual stimuli.

2) Aural-motor comparison--the student is required to relate what he hears as his response to what he remembers as having been his response.

3) Motor-visual comparison--events (1) and (2) provide a basis which allows the student to relate what he remembers as having been his response to what he remembers having seen as the visual stimuli.
2. Note Patterns Read and Notated

Fig. 5—The notating of written note patterns

A. Visual stimulus source.
B. Reception of visual stimuli.
C. Perception and transformation of stimulus patterns into appropriate response patterns.
D. Tactual/kinesthetic-motor responses that result in the notating (copying) of the perceived visual pattern.
B. and D. Reception of tactual/kinesthetic and visual stimuli produced by the response patterns.
C. Perception and transformation of tactual/kinesthetic and visual stimulus patterns into appropriate judgments concerning the accuracy of the notational responses. This involves a visual comparison of what is perceived as having been written (copied) in relation to what had been seen to be copied.
3. Note Patterns Read and Auralized

A. Visual stimulus source.
B. Reception of visual stimuli.
C. Perception and transformation of visual stimulus patterns into appropriate aural imagery responses.
D. Judgments concerning the accuracy of the response come when the written music is sounded either by a recording, or by being performed by the individual or by other individuals. Any of these alternatives would involve some form of tactual/kinesthetic-motor response made following the auralization response.
E. Reception of aural stimulus patterns produced by a recording or by performing activity. If a sounding of the stimulus patterns is not possible, then judgments concerning the accuracy of responses are dependent upon a "re-auralizing" of the pattern or upon conceptual (analytic) or visual comparison cues.

C. Perception and transformation of the respective stimulus patterns into appropriate judgments concerning the accuracy of the auralization responses.

Fig. 6.—The auralizing of written note patterns
4. Note Patterns Read and Analyzed

La Rue (1962) presented a list of musical factors which can be considered in the analysis of musical style. This list can be summarized as follows:

1. Factors related to sound:
   a. Performing media (range, timber, color, etc.)
   b. Compositional texture and fabric
   c. Dynamics
   d. Text-influence (type of text, sound characteristics of language)

2. Factors related to form:
   a. Gross formal patterns of a composition
   b. Developmental processes and techniques
   c. Structural details
   d. Types of formal designs
   e. Text-influence (length, divisions, repetitions, etc.)

3. Factors related to harmony:
   a. Types of tonal systems (key-schemes, modality, polytonality, etc.)
   b. Chordal structures and practices
   c. Linear structures and techniques
   d. Text-influence (harmonic affects, dissonance, etc.)

4. Factors related to rhythm:
   a. Meter and tempo
   b. Dimension of rhythmic units
   c. Textural types and techniques
   d. Patterning
   e. Text-influence (tempo, patterns, alliteration, etc.)

5. Factors related to melody:
   a. Source of material (new, derived)
   b. Function of melodic material in compositional texture
   c. Characteristics (range, media, form, etc.)
   d. Text-influence (speech inflections, melodic affects)

Musical analysis is made in terms of the above factors. In analysis, these factors are identified and conceptualized as structural
and functional elements in music. The act of analysis may include two general approaches involving the visual perception of note patterns.

a. Structural relationships may be recognized directly from the visual perception of note patterns, thus resulting in a visual-conceptual analysis.

b. Structural relationships may be recognized from the aural perception of note patterns. Aural perceptions of structural relationships may then be compared with written music and with visual perceptions of structural relationships, thus resulting in an aural/visual-conceptual analysis. Three methods are available through which aural perceptions of structural relationships in music may take place:

1) The production of patterns by the student on a musical instrument;

2) The production of patterns by means of a recording or another performance;

3) The auralizing of patterns by the student.

Each of these types of conceptual analysis will be considered in turn.
4a. Visual-Conceptual Analysis

Fig. 7.—Analysis based upon the visual perception of note patterns

A. Visual stimulus source.

B. Reception of visual stimuli.

C. Perception and transformation of visual stimulus patterns into appropriate conceptual response patterns. Such response patterns would concern the analysis factors listed on page 39 and would involve the application of a conceptual frame of reference to patterns contained in the written music.

D-1. and D-2. Conceptual responses may also result in concomitant motor responses that consist of placing identifying analytic symbols either at appropriate points on the music (D-1.) or on a separate analytical outline (D-2.).

Judgments concerning the accuracy of responses in this reading task can be produced by repeating the analysis with the aid of the performance of the patterns, either by the individual or by means of a recording. Conceptual responses based upon visually perceived structural relationships can then be compared with conceptual responses based upon aurally perceived structural relationships.
4b. 1) Aural/Visual-Conceptual Analysis: Visual Patterns Sounded by the Student

Fig. 8. --Analysis based upon the reading and playing of note patterns.

A. Visual stimulus source.

B. Reception of visual stimuli.

C. Perception and transformation of visual stimulus patterns into appropriate motor response patterns.

D. Tactual/kinesthetic-motor responses that result in the producing of sound patterns.

D. and E. Reception of tactual/kinesthetic and aural stimulus patterns produced by the response patterns.

A. Visual stimulus source.

B. Reception of visual stimuli.

C. Perception and transformation of visual stimulus patterns into appropriate conceptual response patterns.

C. Comparison of conceptual response patterns based upon aural and visual perceptions of structural relationships. The comparisons thus derived provide accuracy judgments concerning the conceptual responses involved.

F. Tactual/kinesthetic-motor responses that consist of placing identifying symbols either on the music or on a separate analytical outline.
4b. 2). Aural/Visual-Conceptual Analysis: Visual Patterns Sounded from a Recording

Fig. 9.--Analysis based upon a recorded sounding of note patterns

A. Aural stimulus source.
B. Reception of aural stimuli.
C. Perception and transformation of aural stimulus patterns into appropriate conceptual response patterns.
D. Visual stimulus source.
E. Reception of visual stimuli.
C. Perception and transformation of visual stimulus patterns into appropriate conceptual response patterns.
C. Comparison of conceptual patterns based upon aural and visual perceptions of structural relationships. Comparisons thus derived provide accuracy judgments concerning the conceptual responses involved.
F. Tactual/kinesthetic-motor responses that consist of placing identifying symbols either on the music or on a separate analytical outline.
4b. 3). Aural/Visual-Conceptual Analysis: Visual Patterns Auralized by the Student

Fig. 10.--Analysis based upon an auralization of note patterns

A. Visual stimulus source.

B. Reception of visual stimuli.

C. Perception and transformation of visual stimulus patterns into appropriate aural imagery response patterns. These imagery response patterns become the basis for the application of a conceptual frame of reference to the patterns contained in the written music.

D-1. and D-2. The conceptual response patterns may also result in concomitant responses that consist of placing identifying analytic symbols either at appropriate points on the music (D-1.) or on a separate analytical outline (D-2.).

Judgments concerning the accuracy of responses in this reading task can be produced by repeating the analysis with the aid of the performance of the patterns as in 4b. 1.), on page 42, or with the aid of a recording as in 4b. 2.), on page 43. Comparisons can be made between conceptual responses based upon aural and visual patterns.
5. Note Patterns Read and Compared Visually

Fig. 11.—The visual comparing of note patterns

A. Visual stimulus source.

B. Perception of visual stimuli.

C. Perception and transformation of visual stimulus patterns into appropriate comparison responses based on the visual perception of the patterns involved. Visual comparisons may be made between two patterns in one composition or between patterns in different compositions.

Judgments concerning the accuracy of responses in this reading task are immediate and visual. A further check can be provided if the patterns are sounded and compared aurally, or if they are auralized while being visually compared.
G. Note Patterns Read and Compared with Their Performance

Fig. 12.—The comparing of visually perceived patterns with the performance of these patterns.

A. Visual stimulus source.
B. Reception of visual stimuli.
C. Perception of visual stimulus patterns.
D. The sounding of the written music—aural stimulus source.
E. Reception of aural stimuli.
C. Perception of aural stimulus patterns.
C. Comparison of the perceived visual stimulus patterns with the perceived aural stimulus patterns.

Judgments concerning the accuracy of the comparison response occur through a repetition of the sequence.
The music reading cycle—a pattern of perceptual and response behavior common to all reading tasks

Several observations can be made relative to the sequences of events detailed in the preceding discussion.

a. The design for each sequence of events is the same regardless of the specific events involved;
b. The design which exists is repetitious in a cyclical manner, being characterized by identical sub-divisions or phases, and being repeated many times by an individual while in the process of reading a given piece of music.

From these observations it may be concluded that the events within a reading task sequence are ordered by a reoccurring cycle of perceptual, motor and cognitive behavior. This cycle of behavior is referred to in this study as the music reading cycle, and is outline in Figure 13, page 43.

The music reading cycle is characterized by two major phases; the first is referred to as the production phase, the second is referred to as the check-out phase.

The Production Phase of the music reading cycle—The production phase of the music reading cycle leads to the producing of the initial musical response. This phase is characterized by two sub-phases involving a total of four steps.

1. Perception sub-phase:
   a. the reception of the visual stimulus pattern;
   b. the perception of the visual stimulus pattern;

2. Response sub-phase:
   a. the transformation of the perceived pattern into an appropriate response pattern;
Fig. 13. -- The Music Reading Cycle

**Production Phase:**

1. Perception Sub-Phase:
   a. Reception:  
      A. Visual stimulus source.
      B. Reception of visual stimuli.
   b. Perception:
      C-1. Perception of visual stimulus.

2. Response Sub-Phase:
   a. Transformation:
      C-2. Transformation of stimulus patterns into appropriate motor response patterns.
   b. Response:
      D. Production of musical responses.

**Check-Out Phase:**

1. Perception Sub-Phase:
   a. Reception:  
   b. Perception:
      F-1. Perception of sensory stimulus patterns.

2. Response Sub-Phase:
   a. Transformation:
      F-2. Transformation of perceived patterns.
   b. Response:
      G. Production of check-out responses resulting in judgments concerning the accuracy of production phase responses.
b. the production of an initial musical response.

The response which is produced varies in content according to the perceived characteristics of a given reading task.

The Check-Out Phase of the music reading cycle. — The check-out phase of the music reading cycle leads to the producing of a judgment response concerning the accuracy of the musical response produced in the production phase of the cycle. This phase is also characterized by two sub-phases involving a total of four steps.

1. Perception sub-phase:
   a. the reception of the stimulus pattern resulting from the response made during the production phase of the cycle;
   b. the perception of the stimulus pattern resulting from the production response;

2. Response sub-phase:
   a. the transformation of the perceived pattern into an appropriate judgment concerning the accuracy of the response occurring in the production phase of the reading cycle;
   b. the production of the check-out response which consists of judgments concerning the accuracy of the musical response occurring in the production phase of the cycle.

The response which is produced involves a comparison of the various perceptual, motor and cognitive patterns occurring in the total reading cycle. The specific content of these comparisons varies according to the perceived characteristics of a given reading task.

The music reading cycle just described can be considered as a pattern of behavior characteristic of individuals while engaged in the act of reading music. As such it may be considered as a basic outline from
which procedures may be developed for use in music reading testing and training programs. The stimulus presentation and response procedures used by the author in his experimental testing program discussed in Chapter VI illustrate the application of this outline to the development of testing procedures utilizing written responses.
V. MUSIC READING RESPONSES

A review of the sequences of events detailed in Chapter IV indicates that different types of responses are made by individuals in various music reading tasks. In the present chapter, each type of response is listed and briefly defined. The discussion is presented as follows:

1. The perceptual and response events occurring in each music reading task are listed according to the outline provided by the music reading cycle.
2. Individual types of responses are listed.
3. Each type of response is briefly defined.

A listing of perceptual and response events occurring in various music reading tasks

The outline of the music reading cycle presented in Chapter IV, Figure 13, provides a framework for listing in Figure 14 the perceptual and response events which occur in the various music reading tasks. These events are listed in the order of their appearance in the sequences of events detailed in Chapter IV. Pairs of compared response patterns are designated by hyphenated terms. These terms are structured according to the order of appearance of the patterns in the various types of reading tasks described. "Visual - aural" suggests that an initial visually perceived pattern is compared with an aural pattern perceived later in the reading cycle; "aural - visual" suggests that an initial aurally perceived pattern is compared with a visual pattern perceived later in the cycle; "conceptual - conceptual" suggests the comparison of conceptual response patterns; etc.
Fig. 14. -- A listing of perceptual and response events occurring in various music reading tasks

<table>
<thead>
<tr>
<th>READING TASKS</th>
<th>READING CYCLES</th>
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<tr>
<td></td>
<td>Production Phase:</td>
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<tr>
<td></td>
<td>Perception</td>
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<tr>
<td>1. Read and perform</td>
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<td>3. Read and auralize</td>
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<td>4. Read and analyze</td>
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<td>analysis: 1) Pattern</td>
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<td>sounded by student</td>
<td>Aural</td>
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### Fig. 14. (Continued)

#### READING TASKS

<table>
<thead>
<tr>
<th>Production Phase:</th>
<th>Check-Out Phase:</th>
<th>(Compared Patterns)</th>
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</thead>
<tbody>
<tr>
<td>Perception Response</td>
<td>Perception Response</td>
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</tbody>
</table>

2) **Pattern sounded from recording**
- Aural
- Conceptual
- Visual (of written music)
- **Comparison:** Conceptual - Conceptual
  - Aural - Visual
  - Aural - Conceptual

3) **Pattern auralized by student**
- Visual
- Aural Imagery
- Aural (of sounded patterns)
- **Comparison:** Conceptual - Conceptual
  - Visual - Aural Imagery
  - Visual - Conceptual
  - Conceptual - Aural Imagery

5. **Read and compare patterns visually**
- **Visual:**
- **Comparison:** Visual - Visual
  - Visual - Comparison
  - Comparison - Visual

6. **Read and compare visual pattern with its performance**
- **Visual:**
- **Comparison:** Visual - Visual
  - Visual - Aural
  - Visual - Comparison
  - Aural - Comparison
  - Comparison - Aural
  - Comparison - Visual
A listing of types of music reading responses

Four types of responses made in music reading tasks may be listed from a review of the contents of the response columns in Figure 14.

A. Motor Responses
B. Imagery Responses
C. Conceptual Responses
D. Comparison Responses

Each type of response is briefly defined in the following discussion.

Brief definitions of each type of reading response

A. Motor Responses

For the purpose of this study, motor responses are defined as tactual-kinesthetic behavior patterns which occur in various music reading tasks. Some of the more easily identifiable tactual-kinesthetic behavior patterns are listed below:

1. Read and Perform Patterns: Movements of hands, arms, fingers, eyes, head, vocal cords, lips, tongue, legs, feet, etc. while playing on an instrument, singing, or conducting.

2. Read and Notate Patterns: Movements of eyes, head, arms, hands, fingers while notating music.

3. Read and Auralize Patterns: Movements of eyes and head while reading music.

4. Read and Analyze Patterns: Movements of eyes, head, arms, hands, and fingers while reading music, including the performance of music when necessary for analysis.

5. Read and Compare Patterns Visually: Movements of eyes and head while reading music.
6. Read and Compare Written Patterns with Their Performance: Movements of eyes, head, hands, arms, and fingers while reading music, including performance when necessary.

B. Imagery Responses

Studies by King (1939) and Smith (1947) suggest that aural imagery is an important factor in music reading. Smith defined aural imagery as "the ability to hear sounds mentally." In the context of the present study, aural imagery responses are defined as involving both aural memory and aural imagination, i.e., imagery responses may involve the recalling from memory of a previously learned pattern, or they may involve the "imagining" of sound patterns not previously heard.

C. Conceptual Responses

Conceptual responses are defined in the context of this study as involving the perception and recognition of structural factors in musical compositions. Categories of structural factors, as summarized from La Rue, were presented in Chapter IV, page 35. These factors are perceived through direct aural, visual and tactual-kinesthetic experiences with musical compositions. Certain of these factors, such as those dealing with harmonic and tonal relationships, and with formal designs of compositions, are based upon concepts associated with theories and systems of thought concerning music (Daniels, 1946; Cazden, 1947; Packard, 1954; Poland, 1963). Experiences with theories and systems of thought thus strongly influence the conceptual responses made by given individuals relative to these factors.
D. Comparison Responses

Comparison responses involve the comparison of perceptual, motor and cognitive patterns occurring in music reading tasks. The function of these comparisons is to provide judgments concerning the accuracy of the musical responses being produced in a given situation. Such judgments are important in establishing frames of reference essential to further perceptual-response behavior in music reading activities. Figure 15 suggests the larger scope of possible comparison responses. Those comparison responses which have been previously identified in the detailing of task events, Figures 4 through 12 of the present chapter, are indicated in terms of the number given to the reading task through which the responses were identified. Thus, 1. refers to the reading and performing of patterns, 2. to the reading and notating of patterns, 3. to the reading and auralizing of patterns, 4. to the reading and analyzing of patterns, 5. to the reading and comparing of visual patterns, and 6. to the reading and comparing of visual patterns with their performance.

A review of Figure 15 reveals many empty cells in the matrix of comparable response patterns. These empty cells represent possible comparison responses which have not yet been identified. These responses may occur in music reading activities and may be crucial to success in music reading.

Each of the types of responses that have been defined above could be required of students in music reading testing and training programs. The investigation conducted by the author and described in the following chapter (VI) illustrates a testing program utilizing one type of response (written) that has been discussed.
### Task Event Patterns

<table>
<thead>
<tr>
<th>Sensory Patterns:</th>
<th>Sensory Patterns:</th>
<th>Imagery Patterns:</th>
<th>Imagery Patterns:</th>
<th>Conceptual Patterns:</th>
<th>Comparison Patterns:</th>
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**Fig. 15.**—Comparison response possibilities
VI. THE INVESTIGATION

The present chapter contains a discussion of the testing program developed and conducted by the author. The discussion is presented as follows:

1. Concepts basic to the tachistoscopic technique are presented.
2. Considerations relative to the construction of exercise materials are discussed.
3. The content and procedures of the author's testing program are described.

Concepts basic to the tachistoscopic technique

The following discussion is presented for the benefit of the reader who may not be familiar with the tachistoscopic technique. A highly technical and systematic exposition of theoretical propositions is not intended. Rather, the purpose is to present briefly those concepts essential to an understanding of the tachistoscopic technique as a testing and training method.

The behavior of the eye is said to be characterized by a series of alternating movements and pauses (Cobb and Moses, 1962). During the pauses which occur, the eye is at rest and is momentarily fixated upon a given area of the visual field. While the eye is thus fixated, visual images can be brought into focus and perception can occur (Guba and Wolf, 1964). The period during which the eye is fixated is referred to as a fixation pause.
Studies of the fixation pause have shown that only one fixation of the eye is possible in time periods of one-tenth of a second (.1 seconds) or less (Gray, 1922). When the duration of the fixation pause is limited to such short time periods, only those elements in the visual field that can be identified without the aid of a second fixation can be clearly perceived. A tachistoscope is a device which permits the experimental control of the length of time that an individual may view presented visual materials. When visual conditions permitting only single fixations are imposed, as in a tachistoscopic training program, the perceiver is forced to pay attention to as much of the stimulus pattern as is possible during a given fixation. Under these conditions the perceiver is stimulated to develop perceptual habits in which the stimulus elements are instantly recognized and grouped into larger patterns. The grouping of stimulus items into patterns during perception has been considered an essential element in visual perception (Gray, 1922; Tinker, 1929; Bean, 1938; Renshaw, 1943; Sherman, 1947; Ames, 1955; Bartley, 1950; Mooney, 1959). As grouping habits develop, the individual is able to process more and more visual information in a given period of time. As a result, visual skill improves (Renshaw, 1943). When effects of such training are measured by tests involving reading tasks, improvements in reading speed and accuracy are noted (Renshaw, 1945, 1951).

Considerations relative to the construction of exercise materials

In constructing musical materials for the visual training of music students, it is important to consider the visual characteristics
of written music. These characteristics are discussed in the present study in terms of: 1. the spacial dimensionality of written music, and 2. the factors which affect the complexity of written music patterns.

1. Spacial Dimensionality

Written music is a spacial phenomenon involving vertical dimensionality (height) and horizontal dimensionality (length) of spacial forms on the written musical page. Specific written music patterns may involve notes and other symbols arranged in spacial forms that are:
(1) primarily vertical in dimensionality (Figure 16, page 61),
(2) primarily horizontal in dimensionality (Figure 17, page 61) or textural in dimensionality (Figure 13, page 61). Written patterns characterized by textural dimensionality are those in which notes and other symbols are arranged in spacial forms that have varying degrees of both height (vertical dimensionality) and length (horizontal dimensionality) on the musical page.

Musical compositions, when written, are textural in spacial form, i.e., notes and other symbols are arranged in a continuous fabric which has varying degrees of both spacial height and length relative to the expressive intent of the composer. Several types of patterns can be identified and extracted from the fabric of a musical composition. Those types of patterns encountered by students in Fundamentals of Music classes include the following:

1. Two-note intervals, which may be harmonic or melodic in structure;
2. Chords involving varying numbers of notes and accidentals;
3. Melodies involving varying numbers of notes and accidentals and varying rhythmic patterns;
Fig. 16.--Patterns in vertical dimensionality

Fig. 17.--Patterns in horizontal dimensionality

Fig. 18.--Textural pattern
4. Scale patterns involving varying numbers of notes and accidentals;

5. Rhythmic patterns extracted from melodic patterns;

6. Textural patterns involving combinations of the above types of patterns, including:
   a. chord progressions (combinations of chords in a musical fabric),
   b. polyphonic patterns (combinations of melodies and rhythms in a musical fabric),
   c. homophonic patterns (combinations of melodies, rhythms and chords in a musical fabric).

Each of these types of patterns has characteristic spacial forms. Harmonic intervals and chords are vertical spacial forms (Figure 19, page 63). Rhythmic patterns abstracted from melodies are horizontal spacial forms with a consistent vertical size depending upon the height of the written rhythmic notation (Figure 20, page 63). Melodic intervals and melodies are primarily horizontal spacial forms which have varying degrees of vertical height depending upon the contour of a given melodic interval or melody (Figure 21, page 63). Scale patterns occurring in musical compositions usually are melodic in musical character and in spacial form. Scale patterns written as representations of theoretical constructs in textbooks, treatises, classrooms and on student papers, are linear and usually diagonal in shape. They are thus both horizontal and vertical in spacial form (Figure 22, page 63). Chord progressions, polyphonic patterns, and homophonic patterns are textural and possess varying degrees of both vertical and horizontal spacial form (Figure 23, page 63).
Harmonic Intervals Chords
Fig. 19.--Harmonic intervals and chords as vertical spacial forms

Rhythmic patterns as horizontal spacial forms
Fig. 20.

Melodic Intervals Melody
Fig. 21.--Melodic intervals and melodies as horizontal spacial forms with vertical influence.

Fig. 22.--Scales as horizontal patterns with vertical influence

Chord Progression Polyphonic Pattern
Fig. 23.--Textural patterns
The perceptual ease or difficulty of given musical patterns may be affected by the spacial dimensionality of the patterns. Therefore, it is important to consider these factors in the construction of tachistoscopic testing and training exercises.

2. Spacial Complexity

Written music patterns, regardless of dimensionality, contain a variety of symbols combined in varying degrees of complexity. The complexity of patterns is affected by the following factors:

1. the number of symbols involved in a given pattern,
2. the arrangement of symbols within the pattern, including
   a. symmetrical or non-symmetrical arrangements,
   b. closely clustered or more widely distributed arrangements,
   c. pre-learned (i.e. interval, chord and scale patterns encountered by students in Fundamentals of Music classes) or non-pre-learned arrangements.
3. the total amount of space covered by the pattern.

These factors help to influence the perceptual ease or difficulty of written musical patterns. However, no one of these factors will completely account for the perceptual ease or difficulty of a given pattern. For example, larger numbers of notes are more difficult to perceptually group into patterns than are fewer numbers of notes. However, larger numbers of notes arranged in pre-learned patterns may be perceptually easier for a given student than fewer numbers of notes arranged in a pattern with which the student has had no prior experience. In other instances, symmetrical arrangements of notes in patterns with which the student has had no prior experience may be perceptually easier.
than non-symmetrical arrangements of notes involving a pre-learned pattern. The total amount of space covered by a pattern on the written page will also affect the perceptual ease with which it is perceived by a given individual and may cancel or enhance the effects of other factors present in the pattern. The perceptual ease or difficulty of a given pattern is thus a result of the combined effects of these factors.

**A description of the content and procedures of the author's testing program**

The testing program conducted by the author included two tests: 1. the Tachistoscopic Recognition Test and 2. the Notation Copy Test.

1. The Tachistoscopic Recognition Test

The Tachistoscopic Recognition Test was designed as a test of students' skills at the visual recognition of note patterns, and was developed as Part VII, "Note Patterns", of the Ohio State Diagnostic Test Battery, Elements of Music Theory, Section I, Form II (Poland, 1960). Decisions concerning the specific number and types of musical patterns used in the test were made on the following bases: Fatigue has been noted to affect students' performances on tachistoscopically presented visual patterns when more than eighteen to twenty-four patterns are presented in a given session (Renshaw, 1943; Sherman, 1947). The number of patterns which can be presented in a single test session therefore should not exceed twenty-four. The Elements of Music Theory Test of which the Tachistoscopic Recognition Test is a part, is given in a single class period on a single day. It is therefore
impossible to test students tachistoscopically on alternative sets of patterns on different days. The Tachistoscopic Recognition Test was thus of necessity confined to a single set of twenty-four patterns.

With such a limitation in the number of patterns which could be used it was impossible to include representative groups of all of the types of written music patterns listed on pages 60 and 62. It was therefore decided to include only those patterns which reflect the types of patterns used in other parts of the Elements of Music Theory Test. The patterns used in other parts of this test include intervals, chords and scales. While these patterns do not represent the complete scope of written music patterns encountered by music students in Fundamentals of Music classes, they do represent patterns which have particular theoretical significance in music, and as such are of great importance to music students. Students in Fundamentals of Music classes receive extensive training in the aural and visual perception of these patterns, and make extensive use of these patterns in the analysis of musical compositions and in the writing of harmony exercises.

The specific patterns used in the test included (a) six intervals, (b) twelve chords, and (c) six scales. These patterns were selected as follows:

**Intervals.**—The following harmonic intervals were selected to represent an increasing order of size along the vertical spacial dimension (Figure 24, page 60). Five sharps and four flats were distributed over five of the six patterns to increase the complexity of a portion of the patterns and to provide a wider range of difficulty.
One pattern had no accidentals, one pattern had one accidental (a sharp),
and four patterns had two accidentals as follows: one pattern had two
sharps, one pattern had two flats, and two patterns had both a sharp
and a flat (Figure 25, page 60). The intervals were presented in random
order, the first three being in the treble clef, and the last three
being in the bass clef.

Chords.—Six triads and six seventh chords were selected for
the test (Figure 26, page 60). Three triads and three of the seventh
chords were in fundamental position and three of each were in inversions.
Three triads and three seventh chords were presented in the treble clef
and three of each were presented in the bass clef. Eight accidentals
were distributed among the chords. Figure 26, page 60, contains the
chords as presented to the students during the test.

Scales.—Six scales were selected for the test (Figure 27, page
60). Three of the scales are in the major mode (D major, G major, B flat
major), and three of the scales are in the minor mode as follows:
one natural minor (a minor), one harmonic minor (d minor), and one
melodic minor (f minor). Three of the scales are ascending and three
are descending in contour. Three of the scales are in the treble clef
and three are in the bass clef. Accidentals are distributed as follows:
two of the scales have no accidentals, one has only one accidental, two
have two accidentals, and one has three accidentals. Figure 27, page 60,
contains the scales as presented during the test.

The patterns were presented by means of a 750-watt automatic
slide projector. The length of the exposure of each pattern was controlled
Fig. 24.—Intervals of increasing spatial size

Fig. 25.—Intervals as presented in the Tachistoscopic Recognition Test

Fig. 26.—Chords as presented in the Tachistoscopic Recognition Test

Fig. 27.—Scales as presented in the Tachistoscopic Recognition Test
by a tachistoscopic shutter mounted on the lens of the projector. The patterns were projected onto a screen. This screen was no larger than the maximum length and height of the projected patterns and thus served as a fixation area onto which the students were instructed to focus their attention. The level of illumination provided by the projector was such that the projected image (note pattern) could easily be seen with a normal level of illumination in the classroom. As a result the students had sufficient light by which to write the note patterns on the response form. At the same time, no disturbing afterimage was reported by the students as a result of the brightness of the projected note patterns.

Each pattern was presented to the students for an exposure time of one twenty-fifth of a second (.04 seconds). The students were required to notate their perceptions of each projected pattern. The specific instructions used for the presentation of each pattern and for the making of the responses by the students are given in the actual test page presented on page 71. These instructions were read through with the students and the students were allowed to ask questions.

The procedure represented by the instructions presented on page 71 can be reviewed by reference to the production phase of the music reading cycle as discussed in Chapter IV, pages 47-49.

The Music Reading Cycle Tachistoscopic Recognition Test Procedure

A. Production Phase

1. Perception Sub-Phase 1. Preparation period and tachistoscopic presentation of exercise pattern at
   a. Reception an exposure time of one twenty-fifth of a second (.04 seconds).
   b. Perception
2. Response Sub-Phase

a. Transformation patterns.

b. Response

After each exposure, the next pattern in the test was presented with no chance given for the students to determine the correctness of their responses. Thus, no procedures were used relative to the check-out phase of the music reading cycle. Check-out responses are essential to learning and were prohibited in the test so as to minimize any improvement in skills due to learning which might take place in the students during the course of the test.

The test was given to three classes of freshman Fundamentals of Music students at The Ohio State University School of Music. These classes comprise a representative group of freshman Fundamentals of Music students. The test was administered during the respective hour in which each class normally met, and in the respective classroom assigned to each class. The test was unannounced prior to the class hour in which it was given.

2. The Notation Copy Test

The Notation Copy Test involves the second reading task listed in Chapter III, page 33, "the reading and notating of written patterns," and was designed to test students' skills at reading and copying note patterns. The test involves the following types of patterns selected from those listed on pages 60 and 62: (a) four sets of intervals, (b) four sets of chords, (c) four melodies, (d) four chord progressions, and (e) four polyphonic patterns. These types of patterns are encountered by music students in Fundamentals of Music classes and in the study and
This is a test of your ability to see note patterns. Each note pattern will be exposed on the screen for one-tenth of a second. Your task is to look at each note pattern during this short exposure and then to write what you saw in the appropriate place on the form below. The test will contain 24 note patterns arranged as follows:

- **6 intervals**: 3 in the treble clef followed by 3 in the bass clef.
- **12 chords**: 6 in the treble clef followed by 6 in the bass clef.
- **6 scales**: 3 in the treble clef followed by 3 in the bass clef.

Before each pattern is presented, you will hear "ready-one-two". During this preparation, you should look at the area indicated on the screen. The note pattern is visible for such a short time that you must be looking at the place where the note pattern will appear or you will not see it. After each note pattern is exposed, you will be given a short time to write what you saw. Each time you hear the word "ready" look immediately at the screen so that you will be ready to see the next note pattern. Before you begin the test, there will be a practice exposure.

**Practice exposure:**

![practice exposure](image)

(Write here what you see in the practice exposure)

---

**Intervals**

![intervals](image)

**Chords**

![chords](image)

**Scales**

![scales](image)

---

Do not write below this line.

I C S

Total
performance of musical compositions. In Fundamentals of Music course work, students encounter these patterns through dictation exercises, through the study of harmony and the writing of harmony exercises, and through the analysis of compositions. In the study and performance of compositions, these patterns are encountered by students during applied music lessons, while practicing and studying compositions in preparation for applied music lessons and for recitals, and while participating in musical performance groups.

The specific patterns included in the test were selected on the following bases:

Intervals.—The four sets of intervals used in the test included a total of twenty-four intervals. These intervals were selected to represent an increasing order of size along the vertical spacial dimension (Figure 28, page 73). Two sets of patterns contained no accidentals, and two sets of patterns contained a total of eight flats and eight sharps. Two sets of intervals were presented in the treble clef, and two were presented in the bass clef. Figure 29, page 73, contains the patterns as presented to the students in the test.

Chords.—The twenty chords used in the test included twelve triads and eight seventh chords (Figure 30, page 73). The first set of chords consisted of six triads in the treble clef in fundamental position. The second set of chords consisted of six triads in the bass clef with three of the triads in the first inversion and three in the second inversion. The third set of chords consisted of four seventh chords in the treble clef in fundamental position. The fourth set of chords consisted of four seventh chords in the bass clef with one of the chords
Fig. 28. -- Intervals of increasing spatial size

Set #1

Set #2

Set #3

Set #4

Fig. 29. -- Intervals as presented in the Notation Copy Test

Set #1

Set #2

Set #3

Set #4

Fig. 30. -- Chords as presented in the Notation Copy Test
in first inversion, two in second inversion, and one in third inversion. Eight flats and eight sharps were distributed among the twenty chords. Figure 30, page 73, contains the chords as presented to the students in the test.

**Melodies.**—Four melodies were used in the test (Figure 31, page 75) and were selected from course materials used by freshman Fundamentals of Music instructors in the School of Music at The Ohio State University for melodic dictation and sight singing. The first melody was in the key of C major, was written in the treble clef in \( \frac{2}{4} \) meter, and contained no accidentals. The second melody was in the key of d minor, was written in the bass clef in \( \frac{4}{4} \) meter, and contained two accidentals. The third melody was in the key of b minor, was written in the treble clef in \( \frac{4}{4} \) meter, and contained one accidental. The last melody was in the key of G major, was written in the bass clef in \( \frac{6}{4} \) meter and contained no accidentals. The melodies contained a variety of rhythmic patterns. The presence of a specific number of each type of rhythmic pattern was not considered crucial in the selection of the melodies.

**Chord Progressions.**—The chord progressions used in the test (Figure 32, page 75) were selected from course materials used by freshman Fundamentals of Music instructors for harmonic dictation. The first chord progression was in the key of G major, contained three measures in \( \frac{2}{4} \) meter involving five chords, and included two accidentals. The second chord progression was in the key of b minor, contained two measures in \( \frac{4}{4} \) meter involving five chords, and included two accidentals. The third chord progression was in the key of d minor, contained two measures in \( \frac{4}{4} \) meter involving five chords and one passing tone, and included two
Fig. 31.—Melodies as presented in the Notation Copy Test

Fig. 32.—Chord progressions as used in the Notation Copy Test
accidentals. The last chord progression was in the key of C major, contained three measures in $\frac{2}{4}$ meter involving five chords and one passing tone, and included no accidentals.

**Polyphonic Patterns.**—The polyphonic patterns used in the test (Figure 33, page 77), were selected and adapted from keyboard works of Bach. The first pattern was in the key of G major, contained three measures in $\frac{4}{4}$ meter, and involved no accidentals. The second pattern was in the key of C major, contained one measure in $\frac{4}{4}$ meter and involved no accidentals. The third pattern was in the key of b minor, contained two measures in $\frac{4}{4}$ meter and involved one accidental. The last pattern was in the key of b minor, contained two and one-third measures in $\frac{2}{3}$ meter, and involved three accidentals.

Each set of interval and chord patterns, each melody, chord progression, and polyphonic pattern was presented to the students for a time period of ten seconds. The students were requested to copy as many notes as they could in each ten-second time period. The patterns were presented by being projected onto a screen in front of a classroom. The brightness of the projected image was such that the illumination in the classroom was kept at a normal level. The students were thus permitted sufficient light by which to copy the patterns onto the response form. A tachistoscopic shutter was used to control the projected image and each ten-second period was timed by means of a stop-watch. The introduction to the test is presented on pages 73 and 79, and contains the specific instructions and illustrations of the patterns in the test as presented to the students. These instructions were read through with the students prior to the test, and the students were allowed to ask questions.
Fig. 33.—Polyphonic patterns as used in the Notation Copy Test
NOTATION COPY TEST

Introduction

This is a test of your speed and accuracy in copying note patterns. There are five types of note patterns in the test: intervals, chords, melodies, chord progressions and polyphonic patterns. These are illustrated as follows:

Part I Intervals. There are four sets of intervals with six intervals in each set. Two sets of intervals are in the treble clef and two sets are in the bass clef.

Part II Chords. There are four sets of chords, including two sets of triads with six chords per set and two sets of seventh chords with four chords per set. Two sets of chords are in the treble clef and two sets are in the bass clef.

Part III Melodies. There are four melodies. The example illustrates how they will appear on the slides.

Part IV Chord Progressions. There are four chord progressions with five chords in each progression.
Part V Polyphonic Patterns. There are four polyphonic patterns.

These patterns will be projected on the screen. You will be given ten seconds to copy each set of intervals and chords, and each of the melodies, chord progressions and polyphonic patterns. Each note pattern will be preceded by the words "ready - one - two", and concluded by the word "stop". Begin as soon as the image appears on the screen. Copy as you go. Stop immediately when the image is taken off the screen. Do not copy from memory after the image is gone.

It will not be necessary for you to copy the time signatures, key signatures or bar lines which appear in the melodies, chord progressions or polyphonic patterns. These items are included on the answer forms. The intervals and chords are not separated by bar lines on the slides. The staffs on the answer forms are divided by bar lines to help you keep your notation as neat as possible. Place one interval or chord in a space; do not crowd several items into a single space. Before beginning the test there will be a practice set of intervals.
The procedures used in the test can be reviewed by reference to the outline of the production phase of the music reading cycle as discussed in Chapter IV, pages 47 to 49.

The Music Reading Cycle

A. Production Phase

1. Perception Sub-Phase
   a. Reception
   b. Perception

2. Response Sub-Phase
   a. Transformation
   b. Response

Notation Copy Test Procedure

1. Presentation of patterns in ten-second time periods.

2. Response -- Notating of patterns as perceived by students during ten-second time periods.

As in the procedure for the Tachistoscopic Recognition Test, the students were given no chance to check on the correctness of their responses, i.e. to find out how well they had copied the patterns. Thus, no procedures were used relative to the check-out phase of the music reading cycle. Check-out responses were prohibited in order to eliminate any learning which might take place in the students during the course of the test.

The test was given to the same three classes of freshman Fundamentals of Music students who received the Tachistoscopic Notation Test. The test was administered during the respective hour in which each class met, and required twenty minutes for completion. The test was given in the classroom assigned to each class and was unannounced prior to the class hours in which it was given.
VII. PRESENTATION OF DATA

The statistical analysis of test data was undertaken to investigate:

1. The relationships which exist between the students' music skills as measured by their performances on (a) the Tachistoscopic Recognition Test and the Notation Copy Test, and (b) other music tests and scales of measurement now employed by the School of Music at The Ohio State University, and

2. The relationships which exist between the students' music skills as measured by the Tachistoscopic Recognition Test and the Notation Copy Test.

In addition to the scores from the Tachistoscopic Recognition Test and the Notation Copy Test, the analysis included other information which is routinely obtained from all students who are admitted as freshmen to the School of Music at The Ohio State University. This information may be considered in two categories: 1. background information and 2. School of Music Entrance Test scores.

1. Background Information

a. Sex

b. Number of years of piano study

c. Whether a high school performance group had been participated in

d. Whether Music Theory had been studied in the high school program
2. School of Music Entrance Tests

a. Tests used to determine admission to the School of Music

(1) An audition in the proposed area of performance. Scoring is on a five point scale (0 = E, 1 = D, 2 = C, 3 = B, 4 = A).

(2) The Ohio State Psychological Exam. This test is primarily a test of verbal skill. The score used is the total percentile based on The Ohio State University Freshman Norms.

(3) The Ohio State Music Placement Test Battery. This Battery is in three parts, each part containing 50 questions. The complete battery samples 13 different categories of musical skill and information (Poland, 1960a). 

- **Section I Form VI, Aural and Notational Skills**, contains the following parts:
  
  (1) Rhythmic Patterns
  (2) Melodic Patterns
  (3) Notational Errors
  (4) Melodic Dictation
  (5) Scale Notation
  (6) Interval Dictation
  (7) Interval Notation

- **Section II Form II A, Music Recognition**, requires the aural recognition of compositions by:
  
  (1) Composer
  (2) Title

- **Section III Form IV A, General Musical Information**, measures students' knowledge of:
  
  (1) Composers
  (2) Music
(3) Musical Personalities

(4) Technical Terms

Sections I and II are completely controlled by pre-recorded tape. Section III is in standard multiple choice form.

b. The Ohio State Diagnostic Test Battery, Elements of Music Theory, Section I Form II, administered after admission to the School of Music. This is a pre-recorded test designed to measure certain responses to the elemental categories of intervals, scales, and chords presented in aural or visual forms (Poland, 1960b).

In each category scores are obtained on the Speed of Notation, Accuracy of Notation, Output (which is the product of the Speed and Accuracy Scores), Aural Recognition, and Visual Recognition. The Visual Recognition section of this test is, in fact, the Tachistoscopic Recognition Test as described in this study. It was, in part, on the basis of the results reported here that the Tachistoscopic Recognition Test was added as a section to the Elements of Music Theory Test.

Weighted scores in each category of the test may be added to obtain overall measures of Speed, Accuracy, Output, Aural Recognition, and Visual Recognition. This test is used throughout the undergraduate and graduate program in the School of Music to assess achievement. Poland (1960, 1963) has demonstrated that this test gives relatively independent measures of the notational, aural, and visual skills of music students, and that these skills are significantly related to grades in the fundamentals of music courses.

In addition to the tests and other sources of information listed above, the analysis of data also includes first quarter and third quarter accumulative Fundamentals of Music grades.

The relationships which exist between the students' skills as measured by their performances on the Tachistoscopic Recognition Test, the Notation Copy Test, and the other tests and scales of measurement listed above, are inferred from the coefficients of correlation found to exist between the individual scores obtained on these tests. The
square of a coefficient of correlation can be interpreted to indicate the
degree (per cent) of the relationship between the specific variables in­
volved (McNemar, 1955). The number of students whose scores are involved
in the analysis is 62. With this many cases, a correlation of \( \pm 0.33 \) is
statistically significant at the 1% level and may be interpreted to in­
dicate that the relationships which exist between the variables involved
are real. A correlation of \( \pm 0.33 \) indicates a relationship on the order of
10%. In the following discussion, any relationships of less than 10% among
the variables involved are not significant. Correlations of \( \pm 0.33 \) to \( \pm 0.50 \)
represent relationships of 10% to 25% and are considered small. Correlations
of \( \pm 0.51 \) to \( \pm 0.70 \) indicate relationships of 25% to 50% and are considered
moderate. Correlations of \( \pm 0.71 \) to \( \pm 0.80 \) indicate relationships of 50% to
65% and are considered high. Correlations above \( \pm 0.81 \) are considered
very high. In all of the statistical tables to be presented in the
following discussion, coefficients of correlation significant at the
1% level (\( \pm 0.33 \)) are underlined. All coefficients of correlation obtained
from the analysis were carried out to eight digits on the IBM 7094 Com­
puter in the Numerical Computation Laboratory at The Ohio State University.
All correlations presented in the following tables are rounded to two
digits.

In the following discussion the data are presented and state­
ments and inferences are made directly in relationship to the tasks and
skills identified in the Tachistoscopic Recognition Test and the Nota­
tion Copy Test. Before beginning the discussion, it is therefore im­
portant to briefly outline the tasks involved in these two tests. As
was discussed in Chapter VI, both tests utilize the second reading task
identified in Chapter III, page 33, "the reading and notating of written patterns." However, the specific sequences of tasks required in each test differ. Successful performance on each item in the Tachistoscopic Recognition Test involves the following tasks:

1. the perception of the note pattern, which is presented in a brief exposure time of one twenty-fifth of a second (.04 seconds);
2. the remembering of the perceived note pattern long enough to write it on the response form;
3. the writing of the perceived note pattern.

Successful performance on the Notation Copy Test requires the perception and copying of note patterns during ten-second time periods of presentation. There is no restriction on the length of any single fixation pause, and no restriction on the number of notes which an individual may attempt to perceive in a single fixation, except the total number of notes being presented during a given ten-second time period. The individual may look at any given group of notes as many times as he desires in order to correctly copy them. The only restriction is the limitation on the total number of seconds (ten) during which an individual may see and copy the given pattern or set of patterns being presented.
Background variables and the Tachistoscopic Recognition Test.

Table I contains correlation coefficients involving background information and part and total scores on the Tachistoscopic Recognition Test. An examination of Table I indicates that the following relationships were found between students' skills at perceiving, remembering and copying tachistoscopically presented note patterns and other music skills as influenced by background variables:

a. No significant relationships were found involving sex or participation in a high school performance group.

b. Small relationships were found involving participation in a high school music theory class.

c. Moderate relationships were found involving number of years of piano study.

These results are similar to those obtained by Weaver, Buegel and Bean, who found that individuals skilled at sight reading and performing music on the piano also performed well on tachistoscopic tests involving note patterns.
TABLE I

Product-Moment Coefficients of Correlation of Part and Total Scores of the Tachistoscopic Recognition Test with Background Variables for Students (N = 62) Participating in the Investigation

<table>
<thead>
<tr>
<th>Tachistoscopic Recognition Test:</th>
<th>Intervals</th>
<th>Chords</th>
<th>Scales</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>.21</td>
<td>.30</td>
<td>.23</td>
<td>.31</td>
</tr>
<tr>
<td>Years of Piano Study</td>
<td>.52</td>
<td>.52</td>
<td>.33</td>
<td>.50</td>
</tr>
<tr>
<td>Participation in a High School Music Theory Class</td>
<td>.21</td>
<td>.32</td>
<td>.34</td>
<td>.34</td>
</tr>
</tbody>
</table>

Correlations significant at the 1% level are underlined.

Entrance Tests and the Tachistoscopic Recognition Test.--Table II contains correlations involving the Tachistoscopic Recognition Test and the following Entrance Tests: the Aural and Notational Skills Test, the Music Recognition Test, the General Musical Information Test, Audition Grade, and the Ohio State Psychological Exam. An examination of Table II indicates that the following relationships were found between the students' skills at perceiving, remembering and copying tachistoscopically presented note patterns and the students' other musical skills as measured by the entrance tests:

a. No significant relationships were found involving:

1) the General Musical Information Test, which measures students' knowledge of composers, music, musical personalities, and technical terms,

2) the Music Recognition Test, which requires the recognition of compositions by composer and title,
3) the audition grade, which is an evaluation of the students' performance ability as measured by expert judgment,

4) the Ohio State Psychological Exam, which is a measure of the general intelligence strongly influenced by verbal skill.

b. Small relationships were found involving the Aural and Notational Skills Test, which is a measure of students' aural and notational skills.

### TABLE II

Product-Moment Coefficients of Correlation of Part and Total Scores of the Tachistoscopic Recognition Test with Entrance Tests for Students (N = 62) Participating in the Investigation

<table>
<thead>
<tr>
<th>Test</th>
<th>Intervals</th>
<th>Chords</th>
<th>Scales</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aural and Notational Skills Test</td>
<td>.23</td>
<td>.34</td>
<td>.36</td>
<td>.27</td>
</tr>
<tr>
<td>General Musical Information Test</td>
<td>.18</td>
<td>.18</td>
<td>.19</td>
<td>.21</td>
</tr>
<tr>
<td>Music Recognition Test</td>
<td>.18</td>
<td>.21</td>
<td>.14</td>
<td>.22</td>
</tr>
<tr>
<td>Audition Grade</td>
<td>.20</td>
<td>.12</td>
<td>.12</td>
<td>.17</td>
</tr>
<tr>
<td>The Ohio State Psychological Exam</td>
<td>.21</td>
<td>.30</td>
<td>.08</td>
<td>.20</td>
</tr>
</tbody>
</table>

Correlations significant at the 1% level are underlined.

The Elements of Music Theory Test, first quarter and third quarter accumulative Fundamentals of Music grades, and the Tachistoscopic Recognition Test. Table III contains correlations involving total scores on Notational Speed, Notational Accuracy, Notational Output, and Aural Recognition from the Elements of Music Theory Test (The Ohio State
Diagnostic Test Battery), first quarter and third quarter accumulative Fundamentals of Music grades, and the part and total scores from the Tachistoscopic Recognition Test (Visual Recognition scores from the Elements of Music Theory Test). An examination of Table III indicates that the following relationships were found between the students' skills at perceiving, remembering, and copying tachistoscopically presented note patterns and students' other musical skills as measured by the other sections of the Elements of Music Theory Test and Fundamentals of Music grades:

a. Small relationships were found involving scores on Notational Speed, Notational Accuracy, Notational Output and Aural Recognition.

b. Moderate relationships were found involving first quarter and third quarter accumulative Fundamentals of Music grades.
TABLE III

Product-Moment Coefficients of Correlation of Part and Total Scores of the Tachistoscopic Recognition Test with Elements of Theory Total Scores and First Quarter and Third Quarter Accumulative Fundamentals of Music Grades for the Students (N = 62) Participating in the Investigation

<table>
<thead>
<tr>
<th></th>
<th>Intervals</th>
<th>Chords</th>
<th>Scales</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notational Speed</td>
<td>.39</td>
<td>.42</td>
<td>.25</td>
<td>.45</td>
</tr>
<tr>
<td>Notational Accuracy</td>
<td>.22</td>
<td>.28</td>
<td>.37</td>
<td>.34</td>
</tr>
<tr>
<td>Notational Output</td>
<td>.37</td>
<td>.43</td>
<td>.42</td>
<td>.49</td>
</tr>
<tr>
<td>Aural Recognition</td>
<td>.19</td>
<td>.40</td>
<td>.28</td>
<td>.36</td>
</tr>
<tr>
<td>First Quarter Fundamentals of Music Grade</td>
<td>.52</td>
<td>.62</td>
<td>.52</td>
<td>.60</td>
</tr>
<tr>
<td>Third Quarter Accumulative Fundamentals of Music Grade</td>
<td>.44</td>
<td>.54</td>
<td>.42</td>
<td>.54</td>
</tr>
</tbody>
</table>

Correlations significant at the 1% level are underlined
These results are similar to those obtained by Poland (Spohn and Poland, 1964) involving the same tests and Fundamentals of Music grades on additional classes of students (Table IV).

**TABLE IV**

Product-Moment Coefficients of Correlation of Elements of Music Theory Total Scores with First Quarter Fundamentals of Music Grades for Students \((N = 71)\) Used by Poland

<table>
<thead>
<tr>
<th>Notational Accuracy</th>
<th>Notational Output</th>
<th>Aural Recognition</th>
<th>Visual Recognition</th>
<th>First Quarter Fundamentals of Music Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notational Speed</td>
<td>.35</td>
<td>.79</td>
<td>.34</td>
<td>.26</td>
</tr>
<tr>
<td>Notational Accuracy</td>
<td>.02</td>
<td>.40</td>
<td>.83</td>
<td>.61</td>
</tr>
<tr>
<td>Notational Output</td>
<td>.52</td>
<td>.45</td>
<td>.60</td>
<td></td>
</tr>
<tr>
<td>Aural Recognition</td>
<td></td>
<td>.27</td>
<td>.54</td>
<td></td>
</tr>
<tr>
<td>Visual Recognition</td>
<td></td>
<td></td>
<td>.50</td>
<td></td>
</tr>
</tbody>
</table>

Correlations significant at the 1% level are underlined
Table V contains correlations from the author's data which correspond to correlations presented in Table IV.

**TABLE V**

**Product-Moment Coefficients of Correlation of Elements of Music Theory Total Scores with First Quarter Fundamentals of Music Grades for Students (N = 62) Participating in the Author's Investigation**

<table>
<thead>
<tr>
<th>Notational Speed</th>
<th>Notational Accuracy</th>
<th>Aural Recognition</th>
<th>Visual Recognition</th>
<th>First Quarter Fundamentals of Music Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>.17</td>
<td>.81</td>
<td>.50</td>
<td>.38</td>
<td>.68</td>
</tr>
<tr>
<td>.63</td>
<td>.45</td>
<td>.49</td>
<td>.54</td>
<td><strong>.52</strong></td>
</tr>
<tr>
<td>.34</td>
<td>.24</td>
<td>.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.45</td>
<td>.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.45</td>
<td>.52</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Visual Recognition is the Tachistoscopic Recognition Test Total*

Correlations significant at the 1% level are underlined

The results presented in Tables III, IV, and V indicate that skills at perceiving, remembering, and copying tachistoscopically presented note patterns are at least as important to music students as aural and notational skills. At the same time, the results also indicate that visual recognition skills are related to but different from aural and notational skills. Visual recognition skills are thus not only important to musicians, but are different from other skills for which tests were employed in this study.
Background Variables and the Notation Copy Test. —Table VI contains correlation coefficients involving background variables and part and total scores on the Notation Copy Test. An examination of Table VI indicates that no significant relationships were found between students' skills at perceiving and copying note patterns when presented during ten-second time periods and students' music skills as influenced by sex, years of piano study, participation in a high school performance group, or participation in a high school music theory class.

**TABLE VI**

Product-Moment Coefficients of Correlation of Part and Total Scores of the Notation Copy Test with Background Variables for Students (N = 62) Participating in the Investigation

<table>
<thead>
<tr>
<th></th>
<th>Intervals</th>
<th>Chords</th>
<th>Melodies</th>
<th>Chord Progressions</th>
<th>Polyphonic Patterns</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>-.02</td>
<td>.07</td>
<td>-.06</td>
<td>.03</td>
<td>.07</td>
<td>.03</td>
</tr>
<tr>
<td>Years of Piano Study</td>
<td>.02</td>
<td>.09</td>
<td>.10</td>
<td>.01</td>
<td>-.09</td>
<td>.03</td>
</tr>
<tr>
<td>Participation in High School Performance Group</td>
<td>.00</td>
<td>.10</td>
<td>.12</td>
<td>.13</td>
<td>.06</td>
<td>.10</td>
</tr>
<tr>
<td>Participation in High School Theory Class</td>
<td>.15</td>
<td>.11</td>
<td>.16</td>
<td>.24</td>
<td>.29</td>
<td>.24</td>
</tr>
</tbody>
</table>

Correlations significant at the 1% level are underlined
**Entrance Tests and the Notation Copy Test.** Table VII contains correlation coefficients involving part and total scores on the Notation Copy Test and Entrance Tests. An examination of Table VII indicates that no significant relationships were found between students' skills at perceiving and copying note patterns presented during ten-second time periods and students' music skills as measured by any of the Entrance Tests from which data are presented in Table VII.

**TABLE VII**

Product-Moment Coefficients of Correlation of Part and Total Scores of the Notation Copy Test with Entrance Test Scores for Students (N = 62) Participating in the Investigation

<table>
<thead>
<tr>
<th>Notation Copy Test:</th>
<th>Intervals</th>
<th>Chords</th>
<th>Melodies</th>
<th>Chord Progressions</th>
<th>Polyphonic Patterns</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aural &amp; Notation Skills Test</td>
<td>.17</td>
<td>.07</td>
<td>-.05</td>
<td>.22</td>
<td>.14</td>
<td>.14</td>
</tr>
<tr>
<td>General Musical Information Test</td>
<td>.07</td>
<td>.09</td>
<td>-.13</td>
<td>.23</td>
<td>.05</td>
<td>.09</td>
</tr>
<tr>
<td>Music Recognition Test</td>
<td>.05</td>
<td>.01</td>
<td>-.25</td>
<td>.11</td>
<td>-.01</td>
<td>-.01</td>
</tr>
<tr>
<td>Audition Grade</td>
<td>.21</td>
<td>.15</td>
<td>-.08</td>
<td>.20</td>
<td>.20</td>
<td>.17</td>
</tr>
<tr>
<td>Ohio State Psychological Exam</td>
<td>.07</td>
<td>.04</td>
<td>-.02</td>
<td>.17</td>
<td>.14</td>
<td>.11</td>
</tr>
</tbody>
</table>

Correlations significant at the 1% level are underlined
The Elements of Music Theory Test, first quarter and third quarter accumulative Fundamentals of Music grades, and the Notation Copy Test. -- Table VIII contains correlation coefficients involving the Elements of Music Theory Test scores, first quarter and third quarter accumulative Fundamentals of Music grades, and the Notation Copy Test. An examination of Table VIII indicates that the following relationships were found between students' skills at perceiving and copying note patterns presented for ten-second time periods and students' music skills as measured by the Elements of Music Theory Test and Fundamentals of Music grades:

a. No significant relationships were found involving Notational Accuracy, Aural Recognition, or Fundamentals of Music grades.

b. Small relationships were found involving Notational Speed and Notational Output.

These results indicate that visual and motor skills required of students for success in the Notation Copy Test do not appear to be important to music students in terms of success in Fundamentals of Music course work, even though these skills are related to students' notational speed and output skills as measured by the Elements of Music Theory Test.
### TABLE VIII

Product-Moment Coefficients of Correlation of Part and Total Scores of the Notation Copy Test with Elements of Music Theory Scores and Fundamentals of Music Grades for Students (N = 62) Participating in the Investigation

<table>
<thead>
<tr>
<th></th>
<th>Intervals</th>
<th>Chords</th>
<th>Melodies</th>
<th>Chord Progressions</th>
<th>Polyphonic Patterns</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notational Speed</td>
<td>0.30</td>
<td>0.49</td>
<td>0.22</td>
<td>0.20</td>
<td>0.33</td>
<td>0.37</td>
</tr>
<tr>
<td>Notational Accuracy</td>
<td>0.15</td>
<td>0.22</td>
<td>0.15</td>
<td>0.29</td>
<td>0.26</td>
<td>0.30</td>
</tr>
<tr>
<td>Notational Output</td>
<td>0.23</td>
<td>0.43</td>
<td>0.29</td>
<td>0.44</td>
<td>0.44</td>
<td>0.47</td>
</tr>
<tr>
<td>Aural Recognition</td>
<td>0.22</td>
<td>0.14</td>
<td>0.01</td>
<td>0.17</td>
<td>0.13</td>
<td>0.17</td>
</tr>
<tr>
<td>First Quarter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fundamentals of Music Grade</td>
<td>0.21</td>
<td>0.31</td>
<td>0.10</td>
<td>0.23</td>
<td>0.19</td>
<td>0.27</td>
</tr>
<tr>
<td>Third Quarter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accumulative</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fundamentals of Music Grade</td>
<td>0.20</td>
<td>0.27</td>
<td>0.25</td>
<td>0.27</td>
<td>0.14</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Correlations significant at the 1% level are underlined.

Relationships between visual and motor skills required of students in the Tachistoscopic Recognition Test and the Notation Copy Test:

Table IX contains correlation coefficients involving part and total scores on the Tachistoscopic Recognition Test and the Notation Copy Test. An examination of Table IX indicates that the following relationships were found between visual and motor skills required of students in the two tests:
a. No significant relationships were found involving

1) Total scores on the Tachistoscopic Recognition Test and scores for Melodies and Chord Progressions on the Notation Copy Test.

2) Total scores on the Notation Copy Test and scores for Intervals and Scales on the Tachistoscopic Recognition Test.

b. Small relationships were found involving

1) Total scores on the Tachistoscopic Recognition Test and scores for Intervals, Chords, Polyphonic Patterns, and Total scores on the Notation Copy Test.

2) Total scores on the Notation Copy Test and scores of Chords and Total scores on the Tachistoscopic Recognition Test.

TABLE IX

Product-Moment Coefficients of Correlation of Part and Total Scores Between the Tachistoscopic Recognition Test and the Notation Copy Test for Students (N = 62) Participating in the Investigation

<table>
<thead>
<tr>
<th>Notation Copy Test:</th>
<th>Tachistoscopic Recognition Test:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intervals</td>
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<tr>
<td>Intervals</td>
<td>.20</td>
</tr>
<tr>
<td>Chords</td>
<td>.31</td>
</tr>
<tr>
<td>Melodies</td>
<td>.19</td>
</tr>
<tr>
<td>Chord Progressions</td>
<td>.21</td>
</tr>
<tr>
<td>Polyphonic Patterns</td>
<td>.18</td>
</tr>
<tr>
<td>Total Scores</td>
<td>.26</td>
</tr>
</tbody>
</table>

Correlations significant at the 1% level are underlined
As has been discussed earlier in this chapter, the type of response made by students in the two tests is the same, i.e., a written (notational) response made to visually presented note patterns. The types of patterns and even some of the specific patterns used were identical for the two tests. It therefore seems reasonable to assume that scores from the tests would show a fairly high degree of relatedness. The results presented in Table IX indicate that, in fact, the scores obtained in the present investigation have only a small degree of relatedness. These results suggest that skills required of students in various parts of the two tests are different, despite the similarities which exist between the tests in terms of (1) the visual materials used, (2) the mode of perception (visual) of the materials, and (3) the type of response (written) made to the materials.

The differences which have been shown to exist between the two tests may be accounted for by the differences in the manner in which the materials were presented in each test. As has been discussed earlier in this chapter and in Chapter VI, each pattern in the Tachistoscopic Recognition Test was presented at an exposure time of one twentieth of a second (.04 seconds). The pattern could not be seen again and had to be written (notated) on the basis of the individual's perception of the pattern during the brief exposure. The patterns in the Notation Copy Test were presented for ten-second time periods. The individual could look at a given pattern as many times as he desired while perceiving and copying the pattern.
These differences in response conditions between the two tests also permit concomitant differences in ocular and perceptual habits to be manifested in individuals taking the tests. In the Tachistoscopic Recognition Test, patterns have to be perceived in single fixations without intervening eye movements. Individuals who perform successfully on the test are those skilled at perceiving, remembering, and accurately responding to visual patterns. Such individuals may or may not be skilled in musical notation, but they are skilled in accurate seeing and responding, regardless of the speed with which they respond. It is therefore reasonable to assume that the effects of visual skills are clearly evident in results obtained from the Tachistoscopic Recognition Test.

In the Notation Copy Test, patterns can be perceived in one fixation, or in as many fixations as necessary for a given individual. Presumably, several fixations spent upon the copying of one pattern limits the number of notes copied in a given ten-second period. At the same time, however, the speed with which an individual writes the notes and other symbols should increase the number of notes copied in a given ten-second period. It may therefore be that speed in notation compensates for time lost in multiple fixations on single patterns. This indicates (1) that the results obtained from the Notation Copy Test are affected both by visual skills and by motor-notational skills, and (2) that the effects of these skills cannot be separated in terms of the present data. It is therefore quite conceivable that correlations would not be high between the two tests.
Differences in performances on the two tests may thus be accounted for by individual differences in (1) perceptual and response habits, (2) levels of skill involved in these habits, and (3) the degree of relationship existing between the skills involved.
VIII. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The present chapter contains (1) a summary of the study, (2) the major conclusions reached by the author, and (3) recommendations for research.

Summary

1. Summary of the logical framework of thought

Music reading tasks.—In the development of the logical framework of thought presented in this study, music reading activities are analyzed and the following reading tasks are identified:

1. the reading and performing of note patterns,
2. the reading and notating of note patterns,
3. the reading and auralizing of note patterns,
4. the reading and analyzing of note patterns,
5. the reading and comparing of note patterns visually,
6. the reading and comparing of written note patterns with their performance.

The music reading cycle.—The sequences of individual perceptual and response events involved in music reading tasks are detailed, and a common pattern of perceptual and response behavior is identified as being characteristic of all music reading tasks. This common pattern of behavior is referred to as the music reading cycle and contains the following phases and sub-phases:

A. The Production Phase of the music reading cycle leads to the producing of initial musical responses and contains two sub-phases:
1. Perception sub-phase:
   a. the reception of visual stimuli;
   b. the perception of visual stimuli;

2. Response sub-phase:
   a. the transformation of perceived patterns into appropriate response patterns;
   b. the production of initial musical responses.

B. The Check-Out Phase of the music reading cycle leads to the producing of judgment responses concerning the accuracy of the musical responses produced in the production phase of the cycle. This phase also contains two sub-phases:

1. Perception sub-phase:
   a. the reception of stimulus patterns resulting from the responses made during the production phase of the cycle;
   b. the perception of stimulus patterns resulting from the production responses;

2. Response sub-phase:
   a. the transformation of perceived patterns into appropriate judgments concerning the accuracy of the responses occurring in the production phase of the cycle;
   b. the production of check-out responses which consist of judgments concerning the accuracy of the musical responses occurring in the production phase of the cycle.

Music reading responses.—The following types of responses occurring in various music reading tasks are identified and defined:

1. Motor responses are defined as tactual/kinesthetic behavior patterns which occur in various music reading tasks,
2. **Imagery responses** are defined as including both aural memory, i.e. the recalling from memory of a previously learned sound pattern, and aural imagination, i.e. the "imagining" of sound patterns not previously heard.

3. **Conceptual responses** are defined as involving the perception and recognition of structural factors and patterns in musical compositions.

4. **Comparison responses** are defined as involving the comparison of perceptual, motor and cognitive patterns occurring in music reading tasks.

2. Summary of the testing program

Two tests were developed for the testing program conducted by the author: the Tachistoscopic Recognition Test, and the Notation Copy Test. The Tachistoscopic Recognition Test was designed as a test of students' skills at the visual recognition of note patterns, and was developed as Part VII, "Note Patterns", of the Ohio State Diagnostic Test Battery, Elements of Music Theory, Section I, Form II (Poland, 1960). The test consisted of twenty-four patterns and included the following: (a) six intervals, (b) twelve chords, and (c) six scales. These patterns correspond to the types of patterns used on other parts of the Elements of Music Theory Test and are representative of the types of patterns which are of importance to students in Fundamentals of Music classes.

The patterns were presented by being projected onto a screen in front of the classroom. Each pattern was presented to the students for an exposure time of one twenty-fifth of a second (.04 seconds). The length of the exposure time was controlled by means of a tachistoscopic shutter mounted on the lens of the projector. The students responded by notating their perceptions of each projected pattern.
A response form containing written instructions was used by the students. These instructions were read through with the students prior to the test and the students were allowed to ask questions.

The test was given to three freshman Fundamentals of Music classes at The Ohio State University School of Music. The number of students involved totaled 62. These classes comprise a representative sample of freshman Fundamentals of Music students. The test was given unannounced during a regular class hour and in the regular classroom assigned to each class.

The Notation Copy Test.--The Notation Copy Test involves the second reading task listed in Chapter II, page 33, "the reading and notating of written patterns," and was designed to test students' skills at reading and copying note patterns. The test included the following patterns: (a) four sets of intervals, (b) four sets of chords, (c) four melodies, (d) four chord progressions, and (e) four polyphonic patterns. These patterns are representative of the types of patterns which are important to music students in Fundamentals of Music classes.

The patterns were presented by being projected onto a screen in the front of the classroom. Each set of intervals and chords, each melody, each chord progression, and each polyphonic pattern was presented to the students for a time period of ten seconds. The students were instructed to copy as many notes as they could in each ten-second time period. A tachistoscopic shutter was used to control the projected image, and each ten-second period was timed by means of a stop-watch. A response form with written instructions was used by the students.
The instructions were read through with the students prior to the test and the students were allowed to ask questions.

The test was given to the same three classes of freshman Fundamentals of Music students that received the Tachistoscopic Recognition Test. The test was given unannounced during a regular class hour and in the regular classroom assigned to each class.

3. Summary of results from the analysis of data

Relationships between students' music skills as measured by their performances on the tests included in the study—In addition to scores from the Tachistoscopic Recognition Test and the Notation Copy Test, the analysis included other information which is routinely obtained from all students who are admitted as freshmen to the School of Music at The Ohio State University. This information may be listed in two categories: a. background information, b. School of Music Entrance Test scores, and c. Fundamentals of Music course grades.

a. Background Information

1) Sex
2) Number of years of piano study
3) Whether a high school performance group had been participated in
4) Whether Music Theory had been studied in the high school program

b. School of Music Entrance Tests

1) Tests used to determine admission to the School of Music
   a) Audition grade
b) The Ohio State Psychological Exam

c) The Ohio State Music Placement Test Battery:
   Section I Form VI, Aural and Notational Skills
   Section II Form II A, Music Recognition
   Section III Form IV A, General Musical Information

2) The Ohio State Diagnostic Test Battery, Elements of Music Theory, Section I Form II. Scores are obtained on the following:
   a) Speed of Notation
   b) Accuracy of Notation
   c) Output (product of speed and accuracy scores)
   d) Aural Recognition
   e) Visual Recognition (Tachistoscopic Recognition Test)

c. First Quarter and Third Quarter Accumulative Fundamentals of Music Course Grades.

Students' visual recognition skills as measured by the Tachistoscopic Recognition Test were found to have the following relationships with students' music skills as measured by other tests and scales of measurement listed above:

a. No significant relationships (correlations above .33) were found involving:

1) Sex,
2) Participation in a high school performance group,
3) The Music Recognition Test, which requires the recognition of compositions by composer and title,
4) The General Musical Information Test, which measures students' knowledge of composers, music, musical personalities, and technical terms,
5) The audition grade, which is an evaluation of the students' performance ability as measured by expert opinion,

6) The Ohio State Psychological Exam, which is a measure of general intelligence strongly influenced by verbal skill.

b. Small relationships (correlations from .33 to .50) were found involving:

1) Participation in a high school music theory class,

2) The Aural and Notation Skills Test, which is a measure of students' aural and notational skills,

3) Notation Speed, Notation Accuracy, Notation Output, and Aural Recognition from the Elements of Music Theory Test.

c. Moderate Relationships (correlations from .51 to .70) were found involving:

1) Number of years of piano study,

2) First Quarter and Third Quarter Accumulative Fundamentals of Music grades.

These results indicate that visual recognition skills as measured by the Tachistoscopic Recognition Test are important to music students for success in Fundamentals of Music classes, and that these skills are related to but different from other music skills for which tests were employed in the study. These results agree with those obtained by Poland (Spohn and Poland, 1964) involving the same tests and additional classes of freshman Fundamentals of Music students.

Students' skills at perceiving and copying note patterns as measured by the Notation Copy Test were found to have no significant relationships to students' music skills as measured by the other tests and scales of measurement included in the study except in two instances,
Small relationships (correlations from .33 to .50) were found involving Notation Speed and Notation Output from the Elements of Music Theory Test. These results indicate that visual and motor skills required of students for success in the Notation Copy Test do not appear to be important to music students in terms of success in Fundamentals of Music classes. These skills were found to bear no important relationships to students' music skills as measured by the tests employed except in terms of Notational Speed and Notational Output. Visual recognition skills are not included in this statement and are discussed below.

Relationships between visual and motor skills required of students in the Tachistoscopic Recognition Test and the Notation Copy Test.—Small relationships (correlations from .33 to .50) were found to exist between scores on the Tachistoscopic Recognition Test and the Notation Copy Test. These results indicate that the skills required of students in the two tests are different, despite the similarities which exist between the tests in terms of (1) the visual materials used, (2) the mode of perception (visual) of the materials, and (3) the type of response (written) made to the materials. The differences in students' performances which were found between the two tests are accounted for in terms of individual differences in (1) perceptual and response habits, (2) levels of skill involved in these habits, and (3) the degree of relationship existing between the skills involved.
Conclusions

1. Conclusions resulting from the framework of thought developed concerning music reading

The complex nature of music reading.---One of the most significant conclusions that can be drawn from the framework of thought presented in this study is that music reading is quite complex with respect to the psychological and physical events involved. The singular act of visually perceiving printed note patterns, while being a crucial aspect of the reading cycle, nonetheless represents only one category of skills required. Music reading is based upon the concomitant development of perceptual, motor and cognitive skills, and requires that these skills operate in one well-knit behavioral act.

The importance of the analysis of music reading tasks.---The importance of undertaking task analyses in relation to educational research has been discussed by Gagne (1962) and Holland (1962). Gagne concluded that the following principles were useful in the development of training procedures:

a. Any human task may be analyzed into a set of component tasks which are quite distinct from each other in terms of the experimental operations needed to produce them.

b. These task components are mediators of the final task performance; that is, their presence insures positive transfer to a final performance, and their absence reduces such transfer to zero.

c. The basic principles of training design consist of: (a) identifying the component tasks of a final performance; (b) insuring that each of these component tasks is fully achieved; and (c) arranging the total learning situation in a sequence which will insure optimal meditational effects from one component to another.
Holland stated:

"A real revolution in education can be brought about by an experimental analysis of techniques to establish fundamental skills... Such research attempts to discover conditions under which a skill can be created; it attempts to discover new methods and techniques..."

The author's experience in the field of music has led him to the observation that little is understood about the skills required in musical activities. Furthermore, the specific tasks through which these skills operate have scarcely been defined by musicians except in terms so vague as to make experimentation difficult if not impossible. Without some substantial increase in our understanding of the specific behavioral tasks in which musicians engage, and of the skills which are required of musicians to perform these tasks, it will be impossible to improve the largely tradition-bound pedagogical practices which now exist in the field of music.

The analyses of music reading presented in this study permit the identification of the component activities, i.e. behavioral tasks, involved in the reading of music. Success in music reading may be considered as being dependent upon an individual's skill in these behavioral tasks. Successful training programs in music reading, therefore, are those which train individuals in skills relative to these tasks. Analyses of music reading tasks thus provide a framework for the development of programs for the training of individuals in music reading skills.

The analysis of music reading tasks in Chapters III, IV and V indicated that a relatively low number of individual reading tasks are involved in the complex network of musical activities which are detailed
and that even smaller number of individual types of responses are made in these reading tasks. The potential significance of task analysis can be illustrated through the realization that training involving these few responses in relation to the relatively small number of individual reading tasks listed, could have a significant impact upon an individual's ability to sight read and perform music in a wide variety of situations.

The function of the outline of the music reading cycle in the designing of training procedures. — The music reading cycle is an outline of the pattern of perceptual and response behavior characteristic of individuals while engaged in the act of music reading. As such it permits the identification of (1) the types of behavioral events important in the reading of music, and (2) the pattern of occurrence existing among these types of events. Success in the reading of music requires skills in the execution of these types of behavioral events, and requires that these skills function in one-well knit behavioral sequence according to the pattern of occurrence existing among these events. Procedures used in training programs in music reading should therefore incorporate these events according to the behavioral sequence identified in the music reading cycle. The music reading cycle may then be considered as a basic outline for designing procedures to be used in training and testing programs in music reading. The author's testing program illustrates the use of this outline in the development of such procedures.

The importance of the check-out response in the music reading cycle. — The outline and discussion of the music reading cycle suggests that an essential component of the music reading process is the producing of the check-out response whereby the individual gains knowledge concerning
the accuracy of his musical responses. Such knowledge influences the nature of the learning which takes place in the individual and thus alters the frames of reference by which the individual perceives and responds to future stimuli. Knowledge concerning the accuracy of past responses thereby affects the nature of the individual's future responses and the degree of his success as a reader and performer of music. Learning in the context of music reading may be said to be a process not only of developing accurate skills for the production of musical responses, but equally important, of developing the concomitant skills through which the individual gains knowledge concerning the adequacy of his response.

2. Conclusions resulting from the analysis of data

**Importance of visual recognition skills as measured by the tachistoscopic technique.** The analysis of data indicates that visual recognition skills as measured by the Tachistoscopic Recognition Test are at least as important to music students as are other skills measured by the tests and scales of measurement used in this study. Furthermore, visual recognition skills are substantially different from other skills as measured by these tests. These results indicate that music reading programs utilizing the tachistoscopic technique will make significant contributions to the training of students in music reading skills.

**The importance of research in the development of training methods in the field of music.** The discussion (Chapter VII, page 99) concerning the differences which were found between the skills required of students in the Tachistoscopic Recognition Test and the Notation Copy Test, indicates that skills relative to musical tasks are dependent not
only upon the musical materials and modes of perceiving and responding relative to these tasks, but are also dependent upon the perceptual and response habits developed by individuals. These habits may vary considerably from person to person and may produce strikingly different levels of performance in seemingly similar tasks. It is therefore questionable to assume that musical tasks which appear to be the same, and which may even involve identical musical materials and types of responses, are related. It is equally questionable to assume that training in one such task will automatically produce beneficial effects on students' performances in another task. It is therefore important that training methods in the field of music be subject to appropriate experimentation and testing before such methods are assumed to be of value in training students in musical skills.

Recommendations

1. Research in music reading

The following recommendations are made relative to research in music reading:

a. The analysis of music reading undertaken in this study illustrates that music reading is an important aspect of musical behavior. Research should be undertaken to develop methods for training musicians in music reading skills.

b. The data presented in this study demonstrate that skills as measured by a tachistoscopic test are important to music students. Methods which employ the tachistoscopic technique should be developed
for training musicians in music reading skills.

c. The analysis of music reading activities in this study permits the identification of the reading tasks in which musicians become engaged and the types of response made in these tasks. Research should be undertaken (1) to develop procedures which include different reading tasks and different reading responses, and (2) to determine the relative efficiency and utility of such procedures for training musicians in music reading skills.

d. The music reading cycle, as discussed in this study, illustrates (1) the types of perceptual and response events in which individuals must develop skills as they learn to read music, and (2) the sequential order of occurrence which exists among these events for all reading tasks. Stimulus presentation and response making procedures to be used in training methods in music reading should involve these types of events, as related to given reading tasks, and should provide for the occurrence of these events according to the behavioral sequence identified in the outline of the music reading cycle.

2. The investigation of other facets of musical behavior

The analysis of musical activities undertaken in this study was brought to focus on music reading phenomena. However, reading involves only a portion of the skills used by musicians. The analysis of music reading tasks presented in this study may be used as a guide for the delineation of other categories of tasks in which musicians become involved. A few of these other task categories are:

a. Aural recognition tasks.
b. Conceptual-analytical tasks.

c. Tactual/kinesthetic-motor tasks.

Each of these task categories can be systematically detailed through the development of frameworks of thought similar to that presented in Chapters III, IV, and V of this study.

3. Research in music reading as a means to the study of human behavior

Sherman (1947) reached the following conclusion as a result of his application of the tachistoscopic technique in the field of art:

While the experimental program ... was set up primarily in terms of training in art, it is equally an experiment in educational psychology. Many of the classical problems in the psychology of education lie at the heart of the experiment and are met with positive solutions. Gestalt concepts dominate the pattern. Learning is required in terms of the whole, is functional, dynamic, organic, intergrative. Individual differences are respected, and are treated as scientific necessities for the learning act. The role of the teacher is defined as that of arranging situations for the development of central processes in the students, not that of dominating the classroom with his dogma or personality. Methods of teaching the creative act are demonstrated. The curriculum is ordered organically. The results are clear both in qualitative and quantitative respects. A concrete, clear, organically unified, and well-defined situation is presented for research—a rare opportunity in the complex field of educational psychology.

The author's experience in conducting the investigation reported in this study indicates that with appropriate experimental instrumentation, the musical activities of individuals may be experimentally observed and measured without disrupting the "natural" character of these activities. Research in music, like research in art (as indicated by Sherman), can thus be conducted in situations which permit the observer to circumvent the behavioral limitations which often exist in
the laboratory from the fragmentation of activities which is presumed necessary in order to maintain criteria concerning experimental control and measurement.

Experimental investigations of music reading involving the tachistoscopic technique and utilizing the application of the analysis of reading tasks presented in this paper, will permit not only the study of music reading as a topic of concern in the field of music, but will also permit the use of such research for the psychological study of the human behavior involved. Furthermore, the detailing of other categories of music tasks, as suggested on page 101 of this chapter, will permit the definition of further experimental circumstances in which musical as well as psychological questions may be investigated.
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