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AN EXPLORATORY STUDY OF TONALITY APPREHENSION
AND TONAL MEMORY IN YOUNG CHILDREN

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

DOCTOR OF EDUCATION

June, 1949

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CHAPTER I
THE PROBLEM

Statement of the problem.--The purpose of this investigation is to make an exploratory study of the tonality apprehension and the tonal memory abilities in young children as revealed in their singing of familiar songs and dictated musical materials. It is exploratory in the sense that it is a first attempt to determine the relationship of some of the factors underlying tonality apprehension and tonal memory to ability in these two areas of musicality. The factors of age, grade placement, errors, and the patterns of the musical materials are specifically studied.

Significance of this investigation.--There are several specific ways in which this investigation has significance for music education. It may be regarded as a study in the methods of testing musicality in young children. For this purpose the study employs a Gestalt approach, inasmuch as it makes use of a total musical situation in which the response is obtained by means of musical performance. It is suggestive of a means of determining the appropriateness of teaching materials. By discovering what children in a given primary grade can do in a musical situation, it answers, at least in one important respect, the question, "What materials should be used in that grade?" It points to an effective means of determining the needs for corrective music instruction. Subjective methods have usually been adopted to determine such needs. This study will make available to music educators a body of data on tonality apprehension and tonal memory in young children, two areas which have been neglected in investigations of musicality. While several studies have been made on these two traits, little has been done using primary-grade children as

subjects. Finally, the study makes a contribution to the methodology of pupil classification. Whereas ability classification in music has largely been a subjective process, the method of obtaining the data of this study points the way to a more objective means of organizing the class for music instruction.

Derivation of the Problem

The problem of the present investigation arose from observations made by the writer, over a period of several years, of classroom work in grades one to three, together with a rather close study of the singing of four children, aged four and one-half, six and one-half, eight, and nine.

Phenomena observed in the performance of classroom work.--

From the observations of classroom singing of children in the first three grades several generalizations were made. First, similarities seemed to exist in the abilities to sing in tune and to memorize musical phrases readily, regardless of grade placement. Some of the first grade children seemed just as capable with respect to these two abilities as did some of the children in the second and third grades, and some of the third grade children showed a degree of inability with respect to these two traits similar to that shown by some of the children in the second and first grades. Secondly, it was observed that, even in the case of the best singers regardless of grade, some errors were made in the singing of familiar melodies which in no way affected the tonality of the song which they were singing. There was a greater degree of refinement in the singing of the older pupils, and likewise a greater amount of precision, but there was no way of determining the degree of difference that existed in

the refinement and precision of singing. It was noted too, that there was a similarity in the type of errors made by children on all three levels. In the third place, it was not always found true that those who memorized musical sequences most readily sang with the greatest degree of tonal accuracy. While it took some children longer than others to memorize the tonal pattern of a musical phrase, not infrequently their reproduction of it was at least as precise from the tonal standpoint as that of children who grasped the melodic contour more easily.

Phenomena observed in the singing of a small group.--Intensive observations of the group of four children revealed other interesting data. In the singing of a song familiar to all of them it was observed that the youngest varied quite widely from the tonality of the song, the next older showed less tendency to stray from the key (although she did sing some of the wider intervals of the song out of tune), the second oldest displayed a greater ability to sing in tune than did the two youngest children, and the oldest child sang with greater tonality precision than did the other three. After observing these wide differences in the ability to sing in tune, the writer tried to analyze them in terms of pitch recognition and tonal memory. Accordingly, each child was given a series of tone matching tests and a tonal memory test which demanded of them the reproduction of a series of short melodic phrases after one hearing. A study of the data thus obtained revealed that, although there were some differences in the abilities tested, these differences were too slight to explain the variation among the children in the ability to sing with precise intonation.

Relationship of the investigation to the observed phenomena.--

The phenomena discussed in the preceding paragraphs posed several interesting

questions concerning tonality apprehension and tonal memory in young children, questions which could not be answered on the basis of the information acquired through casual observation alone. It appeared that an investigation of a more explicit nature would be necessary if a fuller understanding of these abilities in young children were to eventuate.

Specific Questions

Questions related to tonality apprehension.--The specific questions with respect to tonality apprehension are:

1. How is tonality apprehension distributed among primary-grade pupils?
2. To what degree is the ability of primary-grade children to sing in tune dependent upon or influenced by the melodic pattern of the song?
3. What types of intonation errors are made by them in the singing of familiar songs?
4. What types of pitch errors are made by them in the singing of familiar songs?
5. What other types of errors are evident in their performance?

Questions related to tonal memory.--The specific questions with respect to tonal memory are:

1. How is tonal memory ability distributed among primary-grade children?
2. What types of errors are made by primary-grade children in repeating dictated tone groups after one hearing?
3. What types of errors are made by them in repeating a musical phrase dictated once?

Additional questions.--Additional questions are concerned with the relationship between the two abilities and the relationship of the two abilities to grade placement and chronological age. They are:

1. To what degree do tonality apprehension and tonal memory correlate?
2. What is the relationship of grade level to these two abilities?
3. What is the relationship of chronological age to the two abilities?

Limitations of the Study

In planning the study, certain limitations were accepted. These pertain to the scope of the study, the number and grade placement of the subjects to be used, and the local setting of the study.

Scope of the study.--It was recognized at the outset of the investigation that the field of musicality is of too broad a nature for all facets of it to be included in a study of this size. Mursell¹ suggests thirteen diagnostic signs of musicality; Seashore² lists eight for musical sensitivity, six for musical action, five for musical memory and imagination, three for musical intellect, and three for musical feeling; and Schoen³ classifies four attributes as the bases for musicality, and eight

¹James L. Mursell, The Psychology of Music, pp. 300-319. New York: W. W. Norton and Company, 1937.

²Carl E. Seashore, The Psychology of Musical Talent, pp. 6-12. Boston: Silver, Burdett and Company, 1919.

³Max C. Schoen, The Psychology of Music, pp. 159-166. New York: The Ronald Press, 1940.

for musical talent, which he subdivides into three as primary factors and five as secondary factors. This study is limited to two factors, namely, tonality apprehension and tonal memory.

Number and grade placement of the subjects.--Thirty-nine first-, fifty second-, and forty-six third-grade children of the Edwin D. Smith Elementary School, Dayton, Ohio, were used as subjects.

Local setting of the study.--The significance of the data is limited by the fact that they were obtained from only one school. However, because of the exploratory nature of the study, and the fact that the teaching of music in this school was similar in many respects to that in a large number of schools, it was felt that the data would have significance in that they would reveal conditions, patterns, and problems in tonality apprehension and tonal memory which may be found in many situations.

Assumptions Recognized

In conducting the investigation it became necessary to make certain assumptions. These had to do with (1) the opportunities of the children for training, and (2) their interest in doing the things required of them. Each of these assumptions is discussed in the following paragraphs.

Similar opportunities for training.--Training is presumably one of the most important factors influencing musical growth. It is assumed that all of the children who served as subjects in each grade had had similar training. This assumption is supported by the facts that the same music teacher had instructed all of the pupils from their entrance in the first grade up to the time the investigation was made and

that the course of study for each grade had undergone no material change for the period of years over which the children had been enrolled in the school. A description of the course of study for these grades is presented in Chapter III.

Interest of subjects.--In order to obtain as significant results as possible, it was desired that the performance of the children be the best of which they were capable. This objective called for the interest of the subjects to be maintained at the maximum. While no effort was made to evaluate their interest, it was assumed, on the basis of the eagerness of the children to participate in making the records, that interest was at a high level.

General Procedure

Recordings reviewed.--The data were obtained from an analysis of individual phonograph recordings of familiar songs, tone groups, and a musical phrase. The recordings were obtained from thirty-nine first-, fifty second-, and forty-six third-grade children enrolled in one elementary school. The songs which the children sang were selected from those which had been taught to them during the course of their regular music instruction and which were familiar to each child. The tone groups and the short musical phrase used for the purpose of testing their tonal memory were chosen from the song literature of these children and were typical of the phrase beginnings and endings of the songs which they had been or would be taught.

Preliminary check on procedure.--Before the testing program was conducted, a trial presentation of the material was made to a small

group of children of the first three grades of a near-by school for the purpose of standardizing the recording procedure and of determining the best method of presenting the testing material.

Treatment of recorded material.--After the recordings of the subjects were obtained they were transcribed to graphs arranged in diatonic half-step units to show the correct material and the pupils' response. The transcription of the pupils' response involved a note-by-note comparison of the recorded response with the tones of a piano tuned to A = 440, in agreement with the pitch of the instrument used in the testing situation. The graphs were analyzed in order to obtain the answers to the questions posed for the study.

The recording instrument.--An instantaneous recorder was used in making the recordings of the children used as subjects for the study. This device was chosen for several reasons: (1) the recordings thus obtained would permit greater objectivity in the analysis of the data than would any other device commonly employed in the survey method; (2) the recordings could be played several times in order to check the data; and (3) they could be used for purposes of comparison.

The instantaneous recorder or a similar device has been used as a means of obtaining direct musical responses in testing situations by several investigators of musicality. Thus, Metfessel⁴ made use of

⁴Milton Metfessel, "Technique for Objective Studies of the Vocal Art," Psychological Monographs, 3, Whole No. 167 (1926), 1-40.

phonophotographic equipment in studying the vibrato; Vance and Grandprey⁵ used a recording device, such as the present study employed, in a study of the musical capacities of nursery school children; Hattwick⁶ used the Ediphone to transcribe the musical responses of children in a study of the pitch range and pitch level used by them in the singing of familiar songs; and Drexler⁷ studied intensively recordings made by pre-school children, to determine their ability to carry a melody.

Plan of the report.--The present chapter presents a statement of the problem, its significance and derivation, the questions which it seeks to answer, a definition of limitations, and the general procedure adopted. In the following chapter, literature and research related to this study are reviewed. The procedure adopted in this investigation is presented in detail in Chapter III. Chapters IV and V offer an analysis of the data. A summary of the investigation, with conclusions, applications, and recommendations for further study, is presented in Chapter VI. A bibliography and appendices follow the final chapter.

⁵T. F. Vance and M. B. Grandprey, "Objective Methods of Ranking Nursery School Children on Certain Aspects of Musical Capacity," Journal of Educational Psychology, 22 (November, 1931), 577-585.

⁶M. S. Hattwick, "The Role of Pitch Level and Pitch Range in the Singing of Pre-School, First and Second Grade Children," Child Development, 4 (October, 1933), 281-291.

⁷E. N. Drexler, "A Study of the Ability to Carry a Melody at the Pre-School Level," Child Development, 9 (September, 1938), 319-323.

CHAPTER II
RELATED LITERATURE AND RESEARCH

Introduction

This chapter presents an overview of the literature on musicality and of the reported research which bears upon the two specific areas of musicality which this study investigates. The first section of the chapter reviews the literature on musicality with reference to: (1) nature, (2) diagnosis, (3) development, (4) relationship to intelligence, and (5) inheritability. This material is confined largely to the views of several authorities in the field of the psychology of music. The second section directs attention to the reported research on the problems of tonality apprehension and tonal memory.

The Nature of Musicality

The musical personality.--In describing the musical personality, Mursell states:

We must not think of musicality as a faculty, or instinct, or a special ability or a trait marked off from all the other mechanisms of the mind and operating in isolation.

Music does not depend upon a simple faculty or special ability which exists among various people in various degrees and in some is wholly lacking. Our question always must be: "What psychological conditions and processes are involved in musical behavior?" People cannot be distinguished into musical and unmusical. Nor can we arrange them in a strict order of more or less musical. Many different capacities are involved in dealing with music and these may be combined in many ways. For instance, high ability to perform may be associated with

a lack of musical memory. Productive and receptive musicality may differ.¹

In musical behavior the musical personality displays the use of three basic processes, according to Mursell. These are: (a) affective responsiveness to tone and to tonal-rhythmic patterns; (b) perceptual awareness of tonal relationships; and (c) perceptual awareness of rhythmic groupings. He adds:

The essential point is that musicality depends upon and consists of an awareness of tonal-rhythmic configuration or total pattern and an emotional responsiveness thereto.²

This implies, according to Mursell, (1) that musicality does not depend upon sensory abilities, since these abilities do not guarantee effective musical behavior, and (2) that the psychological capacities upon which musical behavior depends may be found in various degrees and in widely differing combinations. Mursell does concede, however, that extremely poor sensory capacity is a serious impediment to musical behavior.

A second psychologist, Schoen, makes a distinction between musicality and talent. The former he defines as "the aptitude for musical receptions," and the latter as "the aptitude for musical production." "Musicality may be present without much talent, and talent can be present without much musicality" but such talent is of inferior

¹James L. Mursell, The Psychology of Music, p. 332. New York: The W. W. Norton Company, Inc., 1937.

²Ibid., p. 323.

quality when such is the case.³

Mursell and Glenn express general agreement with the first idea presented in this latter statement. They say, "A person may be musical, that is, possess high musicality, without any great executant or creative ability in music."⁴

In a more specific definition of musical talent, Schoen declares that:

Musical talent consists of scores of individual, elemental, specific capacities each contributing its share to the making of the artist. Three specific talents may be summarized as: musical feeling, musical understanding, and musical virtuosity.⁵

Another view on the nature of musicality is expressed by Seashore. He describes the musical mind as first of all a normal mind possessing "those capacities which are essential for the hearing, feeling, and expressing in some form, of music."⁶ It must be able to apprehend the attributes of sound, viz., pitch, intensity, duration, and extensity which (according to the author) after the age of ten, do not vary with intelligence, training, or age. It must likewise possess a strong and vivid memory and imagination, musical intelligence characterized by a background of musical knowledge, interests, tasks, and musical experience, and be capable of expressing itself with feeling and imparting itself emotionally.

³Max Schoen, The Psychology of Music, p. 151. New York: The Ronald Press, 1940.

⁴James L. Mursell and Mabelle Glenn, The Psychology of School Music Teaching, p. 11. New York: Silver, Burdett and Company, 1938.

⁵Max Schoen, op. cit., p. 162.

⁶Carl E. Seashore, "The Musical Mind," Atlantic Monthly, 141 (March, 1928), 358-367.

Seashore further suggests that there are three types of musical mind, tonal, intensive, and temporal, and that high capacity in each of these three types is not essential to marked distinction in musical achievement.

Mursell and Glenn make no attempt at a specific definition of musicality but imply that "its general nature will become apparent through an understanding of the several factors comprising it."⁷ They indicate further that:

Musicality is not a lonely thing in life. It is closely associated with a whole range of excellences, and it (musicality) is dynamic, depending in the last analysis, on the human will.⁸

They re-state the dynamic aspect of musicality thus:

"The musical child is one who possesses an inner urge toward music."⁹

Diagnostic Signs of Musicality

Functions utilized in music tests.--Mursell presents a list of functions "which have been utilized in the various batteries of music tests in the belief that they are diagnostic signs of musicality".¹⁰ They are as follows:

1. Melodic apprehension and response
2. Interval recognition and reproduction
3. Chords and harmonic perception
4. Pitch discrimination

⁷James L. Mursell and Mabelle Glenn, op. cit., p. 11.

⁸Ibid., pp. 36-37.

⁹Ibid., p. 36.

¹⁰James L. Mursell, The Psychology of Music, pp. 300-317.
New York: The W. W. Norton Company, Inc., 1937.

5. Absolute pitch
6. Tonality feeling
7. Rhythm
8. Musical memory
9. Notation
10. Teacher-ratings
11. Discrimination of aesthetic excellence in musical material
12. Emotional, "empathic" and imaginative responses to music
13. Use of music in an individual's life

Four functions in the above list have particular significance for this study. Mursell's analysis of these four functions, namely, melodic apprehension and response, pitch discrimination, tonality feeling, and musical memory, is therefore summarized in the following paragraphs.

Melodic apprehension and response.--The importance of this function as a sign of musicality lies in the fact that "melody is the primary musical phenomenon and the characteristic vehicle of musical significance."¹¹ Mursell states further:

The entire evolution of music may be regarded as accumulation of organizing techniques whereby melodic production is rendered more refined and significant. In the same way the development of musicality in the individual can be seen most clearly in his improvement in melodic apprehension and melodic production.¹²

Pitch discrimination.--Concerning this function, Mursell states:

It is perhaps almost inevitable that pitch discrimination

¹¹ James L. Mursell, op. cit., p. 300.

¹² Ibid., p. 346.

should have been assumed to constitute an important sign of musicality. Pitch differences are among the most obvious phenomena of acoustics and tonal experience.¹³

However, he feels that because pitch discrimination is not a very reliable independent sign of musicality, this function loses a large amount of its importance as a sign of musicality when considered by itself.

Many persons who possess the former (high ability in pitch discrimination) may be lacking in the latter (executant ability). On the other hand, a considerable majority of highly musical persons--just how large this majority is we do not know--will be above average in pitch discrimination.¹⁴

This authority also believes that a low rating on pitch discrimination is a musical barrier and that it indicates defective musicality.

Tonality feeling.--The capacity to feel "finality effects" and to organize musical experience in a particular key or centered around a key note is one of the most important diagnostic signs of musicality, according to Mursell.¹⁵ He infers that this function is directly related to that of melodic apprehension, and that testing to determine the stage of development of this function should be done with the use of test items melodic in nature.

Tonal memory.--In relation to tonal memory, Mursell suggests that "our functioning memory for a musical phrase turns on our grasp of its total structure (the total structure of the phrase) rather

¹³James L. Mursell, op. cit., p. 307.

¹⁴Ibid., p. 307.

¹⁵Ibid., p. 309.

than upon its notes as isolated entities."¹⁶ He cites Heinlein¹⁷ to the effect that tonal memory is a mental phenomenon quite different in function in the musical person than it is in the unmusical person.

Factors of musicality.--Two authorities suggest factors of the musical mind and talent.

Seashore offers two bases for the classification of the factors of the musical mind: "first the attributes of sound, pitch, intensity, duration, and extensity; and second, the generally recognized powers of the human mind." He presents this list:

Musical sensitivity by means of which the individual receives simple forms of impression, such as sense of pitch, sense of intensity, sense of time and sense of rhythm, a sense of timbre, a sense of consonance, and a sense of volume.

Musical action or the capacity to reproduce accurately musical tones, by means of the control of pitch, intensity, tune, rhythm, timbre, and volume.

Musical memory and imagination.

Musical and general intelligence.

Musical feeling and taste.¹⁸

According to Seashore, the mind to be musical must be capable of receiving musical impressions, interpreting and coloring those impressions intelligently and with imagination, and expressing itself with feeling and taste. These are the dominant phases of the

¹⁶James L. Mursell, op. cit., pp. 313-314.

¹⁷Christian Paul Heinlein, "A Brief Discussion of the Nature and Function of Melodic Configuration in Tonal Memory with Critical Reference to the Seashore Tonal Memory Test," Pedagogical Seminary and Journal of Genetic Psychology, 35 (March, 1928), 45-61.

¹⁸Carl E. Seashore, "The Musical Mind," Atlantic Monthly, 141 (March, 1928), 358-367.

musical mind. By obtaining a knowledge of the functioning of these phases in an individual, it is possible to predict with "reasonable certainty the aptitude and probable promise of achievement" of that person.¹⁹

Schoen lists factors of musical talent under two headings: primary and secondary. Under primary factors Schoen lists auditory sensitivity, or a keen ear; musical feeling and understanding, which include absolute pitch, relative pitch, tonal memory, tonal sequence, consonance, harmonic sequence, tonality and rhythm; and musical virtuosity, or the ability of the musical mind to express itself articulately. Under secondary factors he lists intelligence, musical memory, will power and resolve, self-confidence, and temperament.²⁰

Relationship of the ability to carry a lower part and musicality.--Mj sen, in an investigation of the factors of musicality, obtained results which indicated that there is a close relationship between ability to carry a lower part and degree of musicality.²¹

Development of Musicality

Development of general musical ability.--Concerning the development of general musical ability, most authorities are in agreement that there do not exist definite developmental levels. Mursell

¹⁹Carl E. Seashore, op. cit., p. 15.

²⁰Max C. Schoen, The Psychology of Music, pp. 163-166. New York: The Ronald Press, 1940.

²¹J. A. Mj sen, Zur Psychologischen Bestimmung der Musicalitat, 27, (1926), pp. 217-273. As found in Max C. Schoen, op. cit., p. 157.

sums up this matter by stating that "what we seem to find is a gradual advance in efficiency, better discrimination and powers of organization"²² rather than any definite levels of development.

Development of pitch discrimination.--Mursell indicates that pitch discrimination improves with age but that very little is known about how it improves or the age at which it terminates.²³

Schoen cites a study by Jersild and Bienstock which showed that "from the second to the sixth year the development (in pitch discrimination) is decidedly greater than it is from the sixth year to maturity. Children, particularly girls, attain in the first three grades of the elementary school a large portion of their potential pitch ranges as adults."²⁴

Results obtained by the administration of the Seashore tests to children and adults lead Seashore to summarize as follows:

Reduced to its lowest terms, the question of variation with age may be interpreted to mean that we have no evidence of improvement in physiological limit of pitch discrimination with age; a young child of school age and even younger, can hear pitch fully as keenly as an adult. There are, however, marked variations in age among children as to the ability to give evidence of this capacity.²⁵

Development of tonal memory.--According to Seashore, memory, in its many functional aspects, is capable of development on a large scale. In fact, "every normal person is born with a brain capacity

²²James L. Mursell, op. cit., p. 343.

²³Ibid., p. 343.

²⁴Max C. Schoen, op. cit., p. 221.

²⁵Carl E. Seashore, op. cit., pp. 54-55.

for memory far beyond what is ever developed."²⁶ According to this writer, "those with a large capital (in musical memory) will improve, not only in proportion to their capital, but probably in increasing proportions for the larger capital."²⁷

Development of tonality.--Mursell suggests that a basic feeling for tonality becomes apparent at an early age, and that there is a gradual advance in precision and accuracy concomitant with chronological development.²⁸ He quotes Reimers to the effect that "true key feeling in the sense of responsiveness to tonic dominant and subdominant relationships and to the leading tone emerges" at about the age of eleven.²⁹

Development of melodic apprehension.--Mursell suggests three stages of growth in melodic apprehension:

Some of the most important stages as children become older seem to be as follows: (a) an extension of the total range of the child's free melodizing; (b) an increasingly superior command of melodic configuration; (c) the melodic configuration becomes relatively independent of the key in which it has first been experienced.³⁰

Concerning the role that maturation plays in the development of melodic apprehension, he states:

We are confident that the ultimate possibilities and also the approximate moment of the emergence of melodic production depends largely upon physiological maturation.³¹

²⁶Carl E. Seashore, op. cit., p. 236.

²⁷Ibid., p. 242.

²⁸James L. Mursell, op. cit., p. 345.

²⁹Otto Reimers, "Untersuchungen über die Entwicklung des Tonalitätsgefühl im Laufe der Schulzeit," Zeitschrift für angewandte Psychologie, 28 (1927), 193-234. As reported in James L. Mursell, op. cit., p. 346.

³⁰James L. Mursell, op. cit., pp. 346-348.

³¹Ibid., p. 348.

Intelligence and Musicality

Evidence on the correlation of intelligence with musicality seems to indicate that two views are held: (1) that expressed by Seashore, and (2) the European view.

Seashore's view.--In studies of the relation of intelligence to the sensory capacities of pitch, intensity, time, and consonance, Seashore has formulated these conclusions:

Keen intelligence is by no means a guarantee of keen tone discrimination.³²

We find very little agreement between excellence in this test (Seashore test of the sense of intensity) and brightness of children as ordinarily estimated.³³

The elemental sense of time varies slightly with intelligence.³⁴

Since this is a test (Seashore's test of the sense of consonance) of ability in a specific judgment it is an intelligence test, but...it cannot be regarded as an index to general intelligence such as is shown for example, in the ability to do school work.³⁵

On the basis of the above conclusions, Seashore's view may be summarized by the statement that as far as sensory acuity can be accepted as evidence of musicality, there is a general but slight relationship between intelligence and musicality.

The European view.--The results of studies conducted in Europe, mostly in Germany, are in disagreement with the view expressed by Seashore. In a summary on this topic, Mursell states that "European

³² Carl E. Seashore, op. cit., p. 57.

³³ Ibid., p. 98.

³⁴ Ibid., p. 113.

³⁵ Ibid., p. 158.

studies consistently indicate a fairly close relationship between musicality and intelligence.^{#36}

Mursell's explanation of the divergence of the two views.--

The explanation of the divergence of the two views lies in the fact "that we are dealing with two different conceptions of musicality." The American tests deal with the measurement of elemental capacities for sensory discrimination, together with certain other functions, important among which is immediate memory for groups of unrelated tones. The European studies treat musicality as a pattern of behavior that should only be tested in a performance situation. They found that persons tested in this manner who are greatly and successfully concerned with music tend to manifest intelligence higher than the average.

Inheritance of Musicality

Evidence on the inheritance of musicality in general is considered by the authorities reviewed as being meager. Mursell and Glenn indicate that there is "no proof whatsoever that musical ability is inherited as a definite trait like hair color, skin pigmentation, and so forth. We cannot say that nature gives the child a definite musical endowment, and that beyond this nothing can be done about it."³⁷

While this is true of musicality in general, Mursell points out that

³⁶James L. Mursell, "Intelligence and Musicality," Education, 59 (May, 1939), 559-562.

³⁷James L. Mursell and Mabelle Glenn, op. cit., p. 15.

"marked variants of musical capacity are to a considerable degree-- though to exactly what degree we have no idea--due to heredity."³⁸

Seashore pleads for the scientific determination of the inheritability of specific factors of musicality. He writes:

The comparatively large, though scattered literature on the inheritance of musical genius is of little value because it does not deal with tangible fact. It merely essays to determine whether or not the ancestors of a given musician were or were not musical on the whole. The scientific study of musical inheritance must begin with questions like these: How far can we trace in a given lineage a marked development of the sense of pitch; the sense of rhythm; the sense of intensity; etc.?³⁹

Mursell cites studies made by certain European investigators relative to definite inheritance patterns. From their investigations, the following results are summarized:

1. If children come from parents both of whom are musical they will always be musical unless there is low musicality among the grandparents.
2. If both parents are unmusical, there will still be more musical than unmusical offspring, unless all the grandparents are unmusical, in which case the majority of the offspring will be unmusical.
3. If both parents are of low musicality none of the children will be in the extremely musical category.
4. If both parents are extremely musical none of the offspring will be in the somewhat unmusical or very unmusical categories.
5. Where the parents are only slightly divergent in respect to musicality, the average musicality of the offspring will be higher than that of the parents, but where the parental divergence is marked, the average of the offspring will be lower than the parental average.
6. Males are more musical than females.⁴⁰

³⁸James L. Mursell, The Psychology of Music, p. 331.
New York: The W. W. Norton Company, Inc., 1937.

³⁹Carl E. Seashore, op. cit., p. 69.

⁴⁰James L. Mursell, op. cit., p. 334.

Related Investigations on Tonality Apprehension and Tonal Memory

Few investigations have been made on tonality apprehension and tonal memory as such. However, considerable effort has been expended on the study of factors contributing to tonality feeling and tonal memory. It is the purpose of this section of the present chapter to review the studies in these fields that have significance for this investigation.

Tonality Apprehension

There is general agreement among psychologists and musicians that tonality apprehension is one of the most important aspects of musicality. That this function has not frequently been investigated directly is probably due to a lack of appropriate methods for isolating it.

Investigations on tonality apprehension have been conducted with reference to: (1) vocal control of pitch; (2) the ability of subjects to complete musical phrases; (3) the effect of the tonality of one song on the tonality of a second song sung immediately after singing the first song; and (4) the effect of key alteration on tonality judgment.

Vocal control of pitch.--There is no substantial evidence to confirm or refute the idea that vocal control of pitch operates as a factor in tonality apprehension. That it does operate in this direction, however, has been generally conceded by research workers in this field. The degree to which it operates obviously depends upon the manner in which tonality feeling is being determined. Thus, a test demanding that a subject reproduce tones would naturally require a higher degree of vocal control of pitch than one in which the subject makes only a judgment response.

The process by which vocal control of pitch becomes a factor in the apprehension of tonality is as follows, according to Williams and his associates.

When these (reproduction of a tone, control over fine changes of pitch, control over musical intervals, and melodic memory) all function smoothly the result eventuates in another differentiable ability, the maintenance of tonality or orientation in the pitch continuum.⁴¹

Accordingly then, vocal control of pitch, or the ability to reproduce tones, intervals, musical motifs, phrases, and songs becomes a fundamental factor in the determination of the absence or the presence of tonality feeling.

Manifestations of the vocal control of pitch.--Vocal control of pitch is manifested in several different ways. According to the investigations conducted in this field, it may be manifested through the reproduction of single tones, the reproduction of motifs and phrases, the reproduction of intervals, the reproduction of songs, and the determination of pitch range.

Reproduction of single tones, motifs and phrases.--Jersild and Bienstock⁴² used 407 children and sixty-five adults as subjects in a study to determine the number of tones each could sing. The median number of tones for the children was four at age two; six at age three; nine at age four; nine at age five; fourteen at age six; thirteen and five-tenths at age seven; fifteen at age eight; sixteen at age nine; and sixteen at age ten. The adults had a median score of twenty tones.

⁴¹H. M. Williams, C. H. Sievers, and M. S. Hattwick, "The Measurement of Musical Development," Studies in Child Welfare, 7, No. 1. Iowa City, Iowa: State University of Iowa, 1933. p. 68.

⁴²A. T. Jersild and Sylvia F. Bienstock, "A Study of the Development of Children's Ability to Sing," Journal of Educational Psychology, 25 (October, 1934), 481-503.

The girls sang a larger number of tones than did the boys at several age levels, but the differences were not statistically significant.

Williams, Sievers, and Hattwick⁴³ recorded and analyzed the responses of thirteen four-year-old and twenty-eight five-year-old children to single tones and musical phrases. Three levels of ability were distinguished: (1) monotones, (2) partial singers, and (3) singers. Classified as monotones were those whose pitch range was very narrow; no child sang on one tone. Twenty-four per cent of the four-year-olds and sixteen per cent of the five-year-olds comprised this group. Of those who were classed as partials (singing with greater flexibility but still with incorrect pitch), thirty-eight per cent were four-year-old children and forty-eight per cent were five-year-old children. Thirty-eight per cent of the younger group and thirty-six per cent of the older group sang with correct intonation. This study further indicated that the natural range of the child's voice is from middle C to the C an octave higher, and that monotones almost invariably sing at the bottom of their pitch range.

Reproduction of intervals.--The relationship that exists between the singing of intervals and tonality is one that seems at first glance to be quite intangible. Williams and his associates⁴⁴ found that "children may make rather gross errors in the singing of the intervals of a song and still return quite accurately to the keynote at the end of the phrase." They suggest further that "the maintenance

⁴³H. M. Williams, C. H. Sievers, and M. S. Hattwick, op. cit., pp. 70-71.

⁴⁴Ibid., p. 88.

of tonality is a more primitive category than the accurate singing of the intervals." These statements seem to indicate a rather slight relationship between the singing of intervals and tonality feeling. It might be added, however, that in order to measure the ability to maintain tonality, these investigators used the correctness of the return to the key note at the end of the phrase as the only criterion. No evidence was reported in the studies reviewed to contradict the assumption that tonality maintenance depends alone upon the ability to return to the key note, but that this assumption was felt to be untenable is revealed in the statement made by Williams and his colleagues to the effect that by this criterion a monotone might make an excellent score.⁴⁵

Difficulty of intervals.--The relative difficulty of intervals has been studied by several investigators.

Vance and Grandprey attempted to devise objective methods of ranking pre-school children on singing and rhythmic ability.⁴⁶ Twenty-three nursery school children were given tests in the singing of intervals. The investigators found that the average accuracy for singing the descending intervals was higher than it was for the ascending ones.

Williams and his associates⁴⁷ found that wide intervals and those demanding leaps to high levels of pitch are the most difficult.

⁴⁵H. M. Williams, C. H. Sievers, and M. S. Hattwick, op. cit., p. 88.

⁴⁶T. F. Vance and M. B. Grandprey, "Objective Methods of Ranking Nursery School Children on Certain Aspects of Musical Ability," Journal of Educational Psychology, 22 (November, 1931), 577-585.

⁴⁷H. M. Williams, C. H. Sievers, and M. S. Hattwick, op. cit., p. 87.

Drexler,⁴⁸ in a study which sought to determine the ability of children to carry a melody, found that the ascending intervals of seconds are more difficult than the descending intervals of seconds. She used as subjects fourteen nursery school and nine kindergarten children in groups of seven between the ages of three and four years of age; seven between four and five years of age; and nine between five and six. She regards the ability to sing ascending intervals as a measure of maturity in this function of singing.

Drexler's data further revealed that: (1) the intervals of thirds are easier at all ages to distinguish and produce than are the intervals of seconds; (2) there is an increase in ability to sing fourths and fifths with an increase in age; (3) the practice of reducing intervals to holding the same note decreased as age increased; and (4) the older pupils resorted to reducing thirds to seconds less frequently than did younger children.

Jersild and Bienstock⁴⁹ report, on the basis of tests given to forty-seven children ranging from thirty-one to forty-eight months, and twenty-three children ranging from three to eight and one-half years of age, that seconds and thirds were reproduced more readily than the wider intervals. Ascending and descending intervals were reproduced equally well. Half-step intervals were not found to be significantly more difficult than were the diatonic intervals, and children

⁴⁸Ethel N. Drexler, "A Study of the Development of the Ability to Carry a Melody at the Pre-School Level," Child Development, 9 (September, 1938), 319-332.

⁴⁹A. T. Jersild and S. F. Bienstock, "The Influences of Training on the Vocal Ability of Three-Year-Old Children," Child Development, 2 (October, 1931), 272-292.

incorporated semitones into their free melodizing. On the basis of these findings the investigators declared that semitone intervals may properly be used in songs for young children.

Hattwick and Williams⁵⁰ studied the performance of 3902 children between the ages of three years six months and twelve years four months, in an investigation of the ability of these children to reproduce intervals directionally. The data indicate that, of four-year-old children, one in ten has sufficient voco-motor control to sing in the right direction in reproducing two-tone intervals and none can sing such intervals accurately. Of the five-year-old children, every fifth child can sing directionally, and one in ten can sing accurately the interval heard. Sixty-two per cent of the six-year-old children can sing directionally, and fourteen per cent can sing accurately what they hear. With seven-year-olds, eight out of ten will sing directionally, and four out of ten will sing accurately. Eight-year-old children begin to show some resistance to singing because of embarrassment, but eight out of ten will sing directionally and four out of ten will sing accurately. The figures for the nine-year-old children are the same as for the seven- and eight-year-olds. Of the older children, only one out of ten is unable to sing directionally, while six out of ten sing intervals accurately. The results imply a development in the ability to sing intervals with increase in age.

Reproduction of songs.--The ability to reproduce songs is probably the most complex of the component elements of vocal control of pitch. This is indicated by Drexler, who asserts:

⁵⁰M. S. Hattwick and H. M. Williams, "The Measurement of Musical Ability," Studies in Child Welfare, 2, No. 2 Iowa City, Iowa: State University of Iowa, 1935. pp. 2-86.

The ability to carry a melody involves a coordination among many sensory and intellectual factors. To carry a melody accurately the child must link the tones he hears with the tones he reproduces. In addition to possessing sensitivity to the kinesthetic action in his throat and diaphragm and the perception of the tones heard, he must remember the tunes and the individual phrases when attempting to reproduce them vocally. Hence, it is clear that the ability to carry a melody is very complex and far different from the immediate reproduction of tones or intervals.⁵¹

Mursell⁵² suggests that attempts to measure melodic response fall into two large categories: (1) those in which subjects are required to give an active response by singing or playing a given melody; and (2) those in which their response is passive and dependent upon judgment. Of the studies reviewed none falls in the second category. Of those which made use of the active response, the investigations by Drexler, Jersild and Bienstock, Williams, and Flagg were found to be the most significant for the present study.

In the study by Drexler⁵³ cited above, data relative to the ability of pre-school children to carry a melody indicated a definite increase with age. The differences in this ability were most significant between the ages of three to four and five to six years of age. Correlations between the I.Q. and C.A. and the ability to carry a melody were .37 and .59, respectively.

Jersild and Bienstock,⁵⁴ in an investigation of the content

⁵¹Ethel N. Drexler, op. cit., p. 320.

⁵²James L. Mursell, The Psychology of Music, pp. 301-303. New York: W. W. Norton and Company, Inc., 1937.

⁵³Ethel N. Drexler, op. cit., p. 330.

⁵⁴A. T. Jersild and S. F. Bienstock, "The Influence of Training on the Vocal Ability of Three-Year-Old Children," Child Development, 2 (October, 1931), 272-292.

of the spontaneous singing of three-year-old children, found that the tones from middle C to A, a major sixth higher, were sung more readily than tones of a higher pitch. These findings indicate that in the matter of melodic production the voices of young children are placed lower than is commonly supposed. It was often found too, that by transposing the songs to a lower key a more ready response was elicited. In the judgment of these investigators, the usual statement that the child's range is from E on the first line of the treble staff to the E an octave higher has no support in experimental evidence. Such conclusions have fundamental implications for the matter of tonality. From the statements of these investigators it would appear that maintenance of tonality in the singing of melodies would be easier in songs incorporating only those tones in the vocal range of young children than would be the case in songs using higher pitch levels and wider ranges.

Williams⁵⁵ discovered marked individual differences in the ability to learn simple songs in a highly homogeneous group of children at the four-year age level after a whole year of daily training by the group and individual methods. This implies that a specific factor of maturation or some other source of individual differences of an elemental kind is operating at this level.

Flagg⁵⁶ reports a study in tonal learning which is of particular interest in the matter of diagnosing difficulties in melodic

⁵⁵H. M. Williams, "The Measurement of Musical Development," Studies in Child Welfare, 9, No. 1, pp. 4-107. Iowa City, Iowa: State University of Iowa, 1933.

⁵⁶Marian Flagg, "Tonal Learning, the Basic Factor in Musical Growth," Education, 59 (May, 1939), 549-558.

production. Forty-six children from grades three through six were reported as unable to meet class standards in singing a melody with accurate intonation. Data were obtained on their performances in: (1) singing "America," first from the child's choice of pitch and then from the given pitch of G; (2) singing the major scale from D, ascending and descending, using a neutral syllable, and also by numbers; and (3) repeating dictated tonal groups. Four major causes were found to result in inaccuracy of melodic reproduction. These were: (1) physical difficulties such as strain and muscular tension; (2) musical difficulties such as lack of tonal perception, weak tonal imagery, unresponsive singing coordination, and poor tonal judgment; (3) strong rhythmic ability inhibiting tonal attention; and (4) emotional immaturity.

Influences of pitch range on vocal control of pitch.—It was pointed out that Jersild and Bienstock⁵⁷ found that many melodies might be sung more accurately and with better intonation if they were transposed downward from their original keys. That children do use lower pitch levels and a narrower range of tones than is called for in the songs generally presented to them is borne out by several investigations.

Hattwick had a group of ninety-five children between the ages of four and one-half and eight choose forty-seven songs. He gave them the privilege of singing these songs at any pitch level they wished. He gave another group of thirty-seven children, who were between the ages of four and one-half and six, forty-eight practices on one song and tested their singing after the twenty-eighth and forty-eighth practices. The

⁵⁷A. T. Jersild and S. F. Bienstock, op. cit., p. 290.

responses of both groups were recorded and analyzed to determine the mean pitch level used by them in reproducing the songs. His analysis revealed that:

1. The mean pitch level used by these children when singing voluntarily and at a pitch level of their own choice was significantly lower than the pitch level for the same songs as they are printed in song books for these ages.

2. The mean pitch range in semitone value used by these children was significantly smaller for the preschool children, but not so for the first and second grade children, than that found in the song-books for these levels.

3. After forty-eight practices on one song, the mean pitch level for the preschool children was significantly lower than that presented by the teacher for the same practice period. The mean pitch level used after forty-eight practice periods was not significantly different from that used by these children when singing voluntarily any song they wished in any pitch level they chose.

4. After forty-eight practices on the same song the mean range was significantly lower on the musical scale than that presented in the practice period but not significantly smaller in semitone value.

5. A statistical survey of children's songs for this age showed that the mean pitch level is approximately A#¹ and that the mean pitch range is approximately 10.5 semitones. With the exception of the kindergarten children, the first and second grade children sang in a semitone range similar to that of the survey. Comparison of mean pitch levels, however, showed that all groups actually sing significantly lower with known and unknown amounts of practice than they are taught to sing according to the printed songs.⁵⁸

Jersild and Bienstock⁵⁹ concluded that a person realizes a large portion of his potential range while he is still in the first three grades of the elementary school.

Effect of training on vocal control of pitch.--Tonality apprehension, as it is expressed by means of vocal control of pitch,

⁵⁸M. S. Hattwick, "The Role of Pitch Level and Pitch Range in the Singing of Pre-School Children," Child Development, 4 (October, 1933), 281-291.

⁵⁹A. T. Jersild and S. F. Bienstock, op. cit., p. 291.

has been found by several investigators to be amenable to specialized training. Updegraff, Heiliger, and Learned⁶⁰ discovered that a trained group of children definitely improved in ability to reproduce single tones, motifs, and phrases, and picked up in singing ability and interest to a point significantly beyond an untrained group. They used sixteen three-year-old, fourteen four-year-old, and thirty-six five-year-old children arranged in matched groups on each age level. One group received specialized training and the other group did not.

Jersild and Bienstock⁶¹ conducted an investigation of the effect of training on the ability of forty-eight three-year-old children to reproduce pitch and intervals. After six months of training, eighteen of the pupils showed an increase from four to eleven notes in the average number of notes sung. Data on the singing of intervals showed an advance from an average of four intervals to an average of twelve intervals. The investigators concluded that the performance of children in reproducing pitch and intervals can be improved through training and that such training will have a high degree of permanence.

Tonality apprehension expressed in terms of the ability to complete musical phrases.--Kuhn⁶² used thirty subjects (ages not reported

⁶⁰Ruth Updegraff, Louise Heiliger, and Janet Learned, "The Effect of Training Upon the Singing Ability and Musical Interest of Three-Four- and Five-Year-Old Children," Studies in Child Welfare, 14, No. 1 Iowa City, Iowa: State University of Iowa, 1938.

⁶¹A. T. Jersild and S. F. Bienstock, op. cit., p. 291.

⁶²Walter Kuhn, "Experimentelle Untersuchungen über das Tonalitätsgefühl," Beiträge Für Anatomie Des Obres usw, 13, (1919), 254-278. As reported in James L. Mursell, op. cit., p. 310.

by Mursell), who listened to a simple melodic sequence in which the keynote did not appear and then attempted to sing the keynote immediately afterwards. In the course of 228 testings, 78 per cent of the choices centered on the keynote.

Effect of the tonality of one song on the tonality of a second song.--Reimers⁶³ had each member of a group of children, aged from seven to fourteen, sing a required song and then sing a second song immediately afterwards. Their tendency to sing the second song in the same key as the first increased from fifty-six per cent at age seven to ninety-two per cent at age thirteen.

Effect of key alteration on tonality apprehension.--To study the effect of key alteration on tonality apprehension, Reimers⁶⁴ took familiar melodies and distorted certain measures by altering the key in playing them. The subject was given the task of indicating whether or not there was a difference and of locating it. At seven there were no successes, but at fourteen there were only eight per cent errors. He concluded that true key feeling establishes itself at about the age of fourteen.

Tonal Memory

It has been stated by Mursell⁶⁵ that the attempts to treat musical memory as an index of musicality have been unsatisfactory. The

⁶³Otto Reimers, "Untersuchungen über die Entwicklung des Tonalitätsgefühl im Laufe der Schulzeit," Zeitschrift für angewandte Psychologie, 28 (1927), 193-234. As reported in Mursell, op. cit., p. 310.

⁶⁴Ibid., p. 310.

⁶⁵James L. Mursell, op. cit., p. 313.

basis for this contention seems to have been the results of repeated investigations in which the Seashore measures of Musical Talent have been used as the testing media. The trouble with such investigations, he alleges, is that they do not determine a functioning memory for musical phrases, which turns on a grasp of the total phrase structure rather than on the notes as isolated entities. This criticism seems to imply that the appropriate method of determining musical memory should be one of reproduction of complete structures.

Tonal memory and musicality.---Several studies have shown a relationship between tonal or musical memory and musicality. Those by Stumpf, Haecker and Ziehen, Mjølén, Revesz, and Gordon have significance.

Stumpf⁶⁶ studied the musicality of Pepito Areola. Submitting his subject to a series of tests to determine pitch discrimination, absolute pitch, musical memory, ability to transpose, ability to improvise, and to judge the purity of intervals, he found that musical memory was one of the outstanding attributes of his subject.

Haecker and Ziehen⁶⁷ discovered in their study of 208 highly musical, musical, and somewhat musical individuals that only five had poor musical memory. Of all the cases of unmusical persons, only ten had good musical memory. Of a very unmusical group, none had good musical memory.

⁶⁶C. Stumpf, "Akustische Versuche mit Pepito Areola," Zeitschrift für angewandte Psychologie, 21 (1919), 1-11. As reported in Max Schoen, The Psychology of Music. New York: The Ronald Press, 1940, p. 153.

⁶⁷V. Haecker and Th. Ziehen, Zur Vererbung und Entwicklung der musikalischen Begabung, Leipzig: Barth, 1923. As reported in Max Schoen, op. cit., p. 155.

Mjøen⁶⁸ obtained data from 2500 questionnaires on the inheritance of musicality. The results indicated good melodic memory for 100 per cent of the very musical group; for 94 per cent of the musical group; for 75 per cent of the somewhat musical, and only 14 per cent of the unmusical.

Revesz⁶⁹ devised a series of eight tests which were given to sixty-three boys and girls from seven to twelve years of age. The test for melodic memory called upon the child to reproduce vocally a simple melody played for him. From the results of the test, the author concluded that such a test of melodic memory had the highest prognostic value for determining musical ability of all the tests given.

Gordon⁷⁰ working with thirty-eight individuals, found that the median number of repetitions necessary for the memorizing of a melody by musical subjects was four. Thirteen repetitions were necessary for unmusical subjects.

Tonal memory as an index to ability in singing.--Bogan⁷¹ found the Seashore test of tonal memory to be a trustworthy index to minimum ability in singing for 260 elementary and junior high school pupils.

⁶⁸J. A. Mjøen, "Zur psychologischen Bestimmung der Musikalität," Zeitschrift für angewandte Psychologie, 27, (1926), 217-273. As reported in Max Schoen, op. cit., p. 157.

⁶⁹G. Revesz, "Prüfung der Musicalität," Zeitschrift für Psychologie, 85 (1920), 163-209. As reported in Max Schoen, op. cit., p. 168.

⁷⁰Kate Gordon, "Some Tests on the Memorizing of Musical Themes," Journal of Educational Psychology, 2, (1917), 93-99.

⁷¹D. Bogan, "The Significance of Tonal Memory and Sense of Pitch in Musical Talent," Psychological Bulletin, 30, No. 8, (Oct., 1933), 599.

Summary

The material of this chapter has been presented in two sections. The first reviews the literature on four aspects of musicality. The second presents the findings of significant research on tonality apprehension and tonal memory. A summary of this material follows.

Literature on musicality. --Several views are expressed as to the nature of musicality. One view holds that it is not a faculty, trait, instinct, or special ability distinctly marked off from other behavior patterns or existing in isolation. A second view holds it to be a distinct faculty determined largely by the acuity of the sensory mechanisms affected by musical stimuli. A third view distinguishes between musicality and talent.

Diagnostic signs of musicality vary in number. Mursell suggests thirteen. Seashore gives five. Schoen lists three as primary and five as secondary. Mjølén found the ability to carry a lower part as indicative of musicality.

There is general agreement expressed with regard to the gradual development of musicality. Certain aspects were shown to develop as age increased. Seashore questions the development of sensory capacities after the age of ten.

The results of European studies show musicality to correlate highly with intelligence. From the results of studies which used his own tests, Seashore admits only a slight relationship between musicality and intelligence.

The evidence on the inheritance of musicality was found to

be too meager for a significant statement.

Studies on tonality apprehension and tonal memory.--Investigations on tonality apprehension have been conducted with reference to: vocal control of pitch, the ability of subjects to complete musical phrases, the effect of the tonality of one song on the tonality of a second song when sung immediately afterwards, and the effect of key alteration on tonality judgment.

Studies are reviewed on four manifestations of vocal control of pitch: the reproduction of single tones, motifs, and phrases; the reproduction of intervals; the reproduction of songs; and the determination of pitch range.

The studies on the reproduction of single tones, motifs, and phrases indicate that tonal vocabulary and ability increase as age increases, and that this ability is susceptible to training.

Investigations of the ability to sing intervals report that ascending intervals are more difficult than descending ones; thirds are easier to sing than seconds; semitone intervals are incorporated into the free melodizing of children; and the ability to sing intervals of all kinds advances with age. This ability is likewise amenable to training to a marked degree.

Research on the ability of children to sing songs discloses that the ability to carry a melody improves with maturity, and that children sing significantly lower even after training than is commonly suggested.

Reimers analyzes the effect of the key tonality of one song on the key tonality of a second song when sung immediately afterwards.

The tendency to sing the second song in the key of the first increases as age increases. He also reports on the effect of key alteration on tonality. The ability to recognize key alteration increases as age increases.

Several studies on tonal memory show it to be an attribute of musical people. Tonal memory is lacking in unmusical people. A performance type of tonal memory test has high prognostic value in determining musical ability. The Seashore tonal memory test is reported to be an index of minimum ability in singing.

CHAPTER III

PROCEDURE

Introduction

This chapter analyzes the procedure employed to obtain the data for the study. Following a general statement of the procedure, there are presented a description of the subjects and their community background, and a brief account of the course of study in music offered in their school situation. Subsequent sections of the chapter review the method of selecting the testing materials; describe the apparatus used in the collection of the raw data; present the results of a trial presentation of the testing materials; and describe the recording procedures and treatment of the data.

General Procedure

The singing of 135 primary-grade children was recorded and studied for the purpose of ascertaining their tonality apprehension and tonal memory ability. Each child was asked to record several familiar songs. A group of fifty-eight pupils also recorded three series of short tone groups and a musical phrase. All of the children were pupils of the Edwin D. Smith Elementary School of Oakwood, Dayton, Ohio.

The Subjects

Number and grade placement.--Thirty-nine first-grade, fifty second-grade, and forty-six third-grade pupils comprised the group of children used as the subjects for the study.

Method of computing ages.--The ages of all subjects were computed in terms of months figured to the nearest month from the exact birth date to the recording date. For example, a pupil in the first grade was born on June 8, 1935. His recording date was March 16, 1942. His age, expressed in months to the nearest month, was eighty-one months at the time he made his recordings. The exact birth dates were obtained from the school records.

Data on age and grade placement.--Table I shows the ages and grade placement for all pupils at the time the recordings were made.

Community background of subjects.--The village of Oakwood is a residential suburb of the industrial city of Dayton, Ohio. In 1940 it had a population of 7,891. It contains no industrial or manufacturing establishments and only a few neighborhood business concerns, including grocery stores, drug stores, and theaters. It is independent of Dayton from both the administrative and educational standpoints, functioning under a charter form of civic government, and administered by a city manager. It has an independent board of education.

Approximately ninety per cent of the employed residents of the village work in and around Dayton either as professional or industrial employees. The majority own or are in the act of purchasing their own residential properties. As a whole, they are in sympathy with a well-rounded educational and cultural program. They support enthusiastically the school and community athletic, social, and cultural activities, believing that such things are needed for the all-around development of their children.

In general, the home-life and activities are wholesome and secure, and present an environment of middle-class culture and refinement

TABLE I
DISTRIBUTION OF THE AGES OF 135 PRIMARY-GRADE
PUPILS OF THE EDWIN D. SMITH SCHOOL OF DAYTON, OHIO

Ages (months)	Frequencies			Total
	Grade One	Grade Two	Grade Three	
112			1	1
110			7	7
108		1	5	6
106		-	5	5
104		-	11	11
102		2	3	5
100		-	9	9
98		7	3	10
96		4	-	4
94		12	-	12
92		7	-	7
90		6	1	7
88	2	6	-	8
86	-	5	1	6
84	7			7
82	6			6
80	9			9
78	6			6
76	7			7
74	1			1
72	1			1
Total	39	50	46	135
Mean	81.03	94.04	104.74	93.04
S. D.	3.58	4.62	5.00	5.28

of a high order. At first glance it might be surmised that the children are allowed too much freedom of thought and activity, but nothing has developed in the social life of the community to substantiate this criticism. Cases of juvenile delinquency or of social maladjustment are few in number and of little significance to the social structure of the village.

Educational environment.--The formal educational facilities of the community consist of a high school, junior high school, and two six-grade elementary schools. There are sixty-one members of the teaching staff. Twenty-seven of these possess master's degrees, twenty bachelor's degrees, and fourteen are in the process of completing degree requirements.

The educational philosophy of the system is moderately progressive. High standards of scholarship seem to be a desired goal. Evidence of scholastic achievement is revealed by the results obtained by the pupils who participated in the state scholarship tests, College Board examinations, and the number of admissions to colleges and universities. During the year in which the present study was conducted, the following figures were compiled:

1. The results of the state scholarship tests show that fifty-five out of sixty-two pupils placed in the district contest and twenty-seven in the state.

2. Figures on the College Board examinations reveal that ten pupils entered, all passed, and nine who applied for university entrance were accepted.

3. Eighty-seven per cent of the year's graduating class applied for college entrance and were accepted.

The school population of the community at the time the data were compiled comprised 319 pupils in the Edwin D. Smith elementary school, 255 pupils in the Harmon Avenue elementary school, 329 pupils in the junior high school, and 332 pupils in the senior high school.

Music Course of Study in the Primary Grades
of the Edwin D. Smith School

Interview with the elementary school music teacher.--To ascertain the school music background of the pupils used in the study, an interview was held with the elementary school music teacher. She had been in this position for two years, and prior to this had been kindergarten teacher in the same school for eight years.

Questions asked to determine the school music background of the primary grade pupils.--The following list of questions guided the interview:

1. How many minutes per week are devoted to music instruction for each grade?
2. Are the grades divided into separate classes?
3. What are the average sizes of the music classes in the first three grades?
4. Where are the classes instructed?
5. What facilities are provided for instruction?
6. What types of musical activities are engaged in by the pupils? (Song singing? Listening to music? Remedial? Rhythm? Music reading? Instrumental?)
7. Are special programs given throughout the year?
8. What are the general aims for music education for each

grade?

9. What materials are used for instruction?

10. What other school musical activities besides formal class instruction are engaged in by the pupils of the first three grades?

Answers to the above questions are presented in the following paragraphs.

Data on the school music course of study.--In the elementary grades sixty minutes per week were given to class instruction in music. There were two classes in each grade.

The class sizes for the grades investigated averaged for grade one, twenty-two; grade two, twenty-seven; and grade three, twenty-four pupils.

At the time the data were collected all music classes for the three grades studied were conducted in a special music room under supervision of the music teacher, assisted by the classroom teacher. The same room was used for the purpose of collecting the data.

The facilities provided for instruction, exclusive of the especially designated room for music instruction, included the following equipment: one upright piano of good quality; a modern electric reproducing phonograph and radio; a well-organized and adequately stocked library of phonograph recordings; a modern standard type instantaneous recording machine; adequate blackboard space; and proper seating equipment to insure correct singing posture. In spite of the fact that the room had not been especially designed for a music room when the building was constructed, such alterations as had been made resulted in the

provision of a room quite satisfactory to the teaching demands of the subject. One improvement was felt to be needed: some form of acoustic treatment for the walls and ceiling.

The musical activities engaged in by the pupils during the course of music instruction included all those suggested by the interviewer, some to a greater degree than others, however. The major portion of the music course of study was devoted to the teaching and singing of songs. Next in importance was the listening to music, an activity which was conducted in these grades for two purposes: (1) to facilitate the development of rhythm, and (2) to enhance the enjoyment of the music period. Of these two purposes the first received the greater consideration in time allotment.

No remedial instruction was given individually. All devices used to develop the singing voice and train for pitch recognition were a part of class procedure. Rhythm study was obtained through the singing of songs and participation in rhythmic movement to the accompaniment of the piano and phonograph. No instruction was attempted for the mastery of set rhythmic patterns in these grades. Music reading for the development of skill in sight reading was not given. Some effort was made in the third grade to indicate the directional aspects of the melody by calling attention to the relative position of the notes on the staff. No provision was made in these grades for formal instrumental instruction. Again in the third grade, the children were made acquainted with the sight and the sound of the more familiar instruments: the violin, cello, clarinet, saxophone, coronet, snare drum, and trombone, through the media of illustrated charts and phonograph recordings. Two pupils in

the third grade were studying violin, and six the piano. Several of the first and second grade children were studying piano at the time the investigation was conducted.

These grades participated in two special programs during the year: a Christmas carol program, given for the community, and a spring program usually given for a school assembly.

Instruction in music in these grades was given for the purpose of: (1) instilling in the children a desire to sing and express themselves musically to the degree to which each is capable; (2) assisting all the children to find and use their voices in such a manner as will give satisfaction to each and promote musical growth; (3) developing to the greatest extent their abilities of pitch recognition, rhythm, and tonal memory; and (4) promoting the desire to listen to beautiful music, and to the extent of their mental and emotional development, the ability to form likes and dislikes based upon a simple analysis of what they hear.

The materials used for the purpose of instruction included song texts, placed in the hands of second and third grade children, pictures to illustrate and enlarge upon the meaning of the songs, phonograph recordings of instrumental and vocal music, a radio, and in the third grade, literature of an appreciational nature such as books containing stories about musicians, instruments, or people who love music, and short magazine stories written expressly for children of this age.

Musical activities other than formal class instruction engaged in by the pupils of the first three grades included: (1) lessons

on the violin and piano for a few pupils, as mentioned above; (2) the making of bottle or glass musical instruments; (3) an occasional informal classroom concert by individual pupils; and (4) classroom serenades in which one group visited and performed for another group of the same grade level.

A few creative projects had been carried on. These had resulted in the creation of songs and the construction of drums and tomtoms from cereal boxes and other available materials. Lack of facilities hindered the construction of intricate instruments.

Selection of Material

Type of material.--Material of two types was selected for the study: (1) material to be used in recording the responses of the pupils to determine their ability with respect to tonality apprehension, and (2) material used in recording the responses of the pupils to determine their ability with respect to tonal memory.

Material used to determine tonality apprehension.--The material used to determine the tonality apprehension of the children consisted of familiar songs. Two criteria guided the investigator in the choice of the songs to be used: (1) they had to be familiar to all of the children, and (2) they had to be songs which the children enjoyed singing. Manuscript copies of the songs are shown in Appendix A.

Material used for the testing of tonal memory.--The materials used for the purpose of testing tonal memory were of three types: (1) the songs used in testing tonality apprehension; (2) tonal groups, consisting of five series of four tones each, five series of five tones each, and five series of six tones each; and (3) a four measure musical

phrase. The two latter types of material were selected from an analysis of the melodies of the songs taught to these grades.

A manuscript copy of the tone groups and the phrase is presented in Appendix B.

Equipment Used for the Collection of Data

Types of equipment.--Two types of equipment were employed in the collection of the raw data for the study; (1) a portable instantaneous recorder* with which were used flat recording disks; and (2) an electric metronome.

The use of the recording machine made it possible for the responses of the children to be studied and checked several times, and thus permitted considerable objectivity in the analysis of the data. The use of the metronome made it possible for the examiner to dictate the tone groups and the phrase at the same rate of speed for each child and thus keep constant the factor of speed of presentation. It likewise served as a check on the pupils' rhythmic constancy, although no effort was made to investigate this ability.

Figures 1 and 2. present pictures of the recorder, the recording disc, and the electric metronome. Figure 3 presents a picture of one of the subjects recording the singing of America. Figure 4 illustrates the type of graph used in the analysis of the data. The song "Dinky Donkey" is here presented in graphic form.

*The machine used was a portable recorder of single speed (78 r.p.m.) manufactured by the Galvin Corp., Chicago, Ill., and sold under the trade name of Motorola.

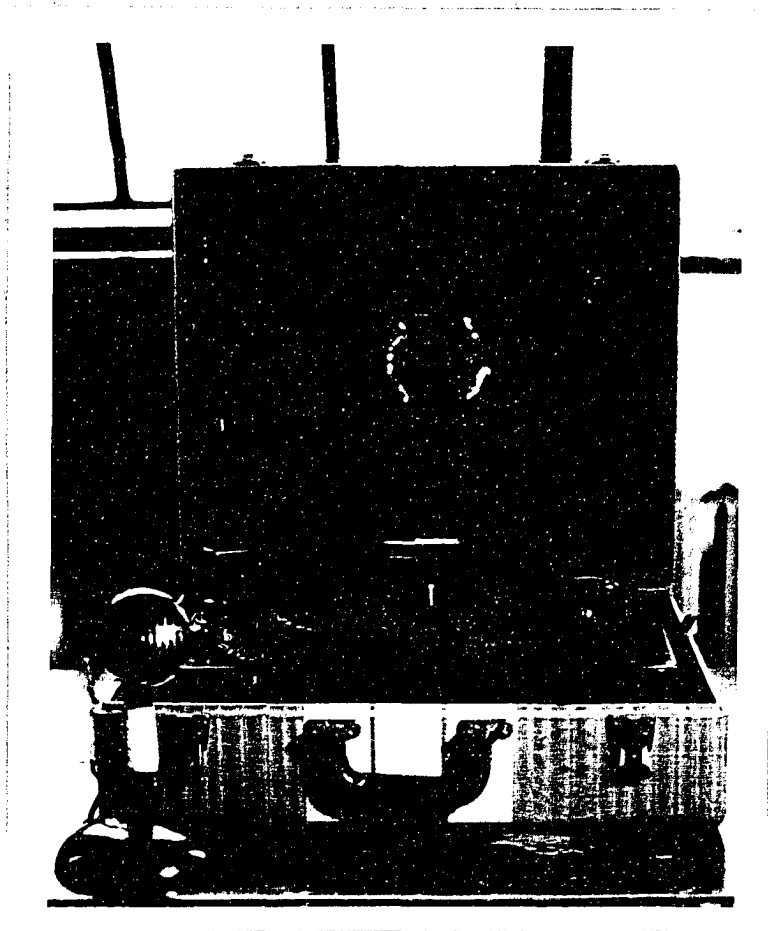


Figure 1.--The Motorola Instantaneous Recorder.

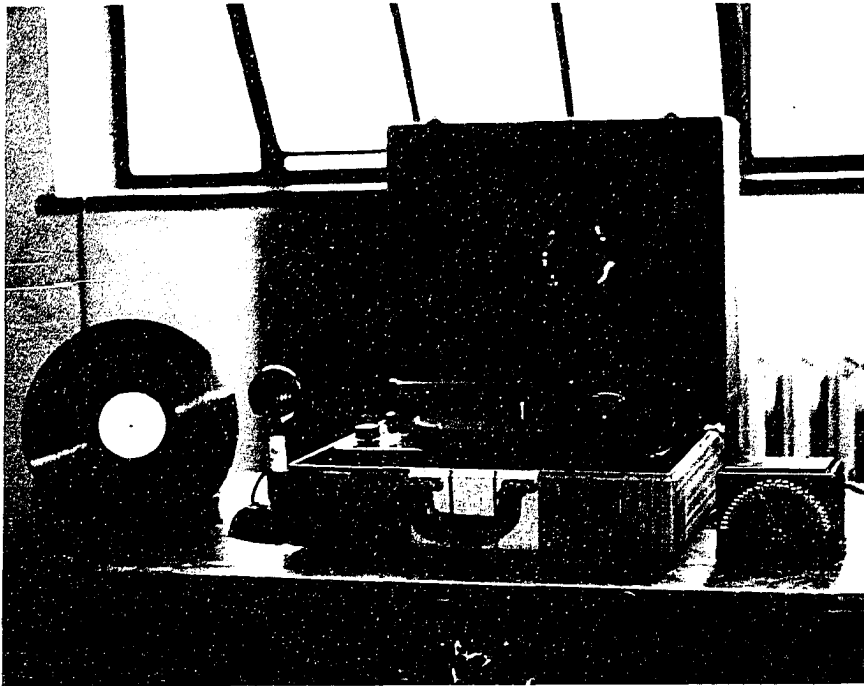


Figure 2.—Ten-inch Paper-Type Recording Disc,
Recorder, and Electric Metronome.



Figure 3.--A Subject Recording the Singing of America.

Pupil No. _____ Grade _____ Age _____

Record No. _____ Song Dinky Donkey

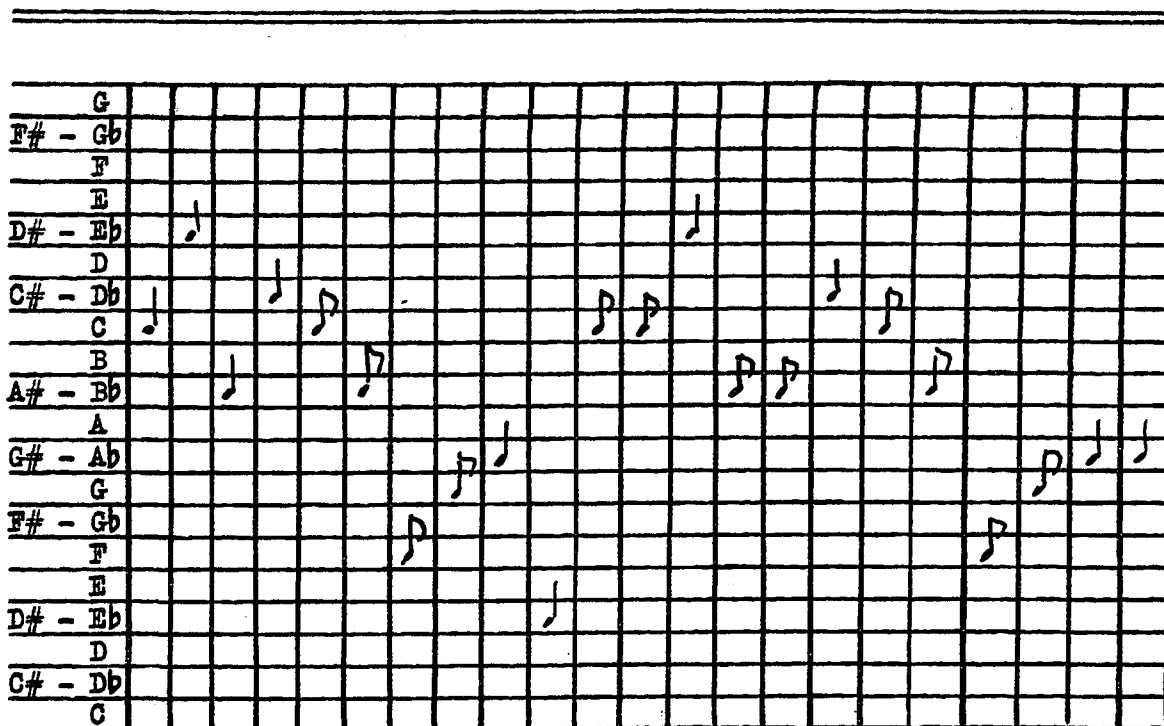


Figure 4.--Type of Graph Used in the Analysis of the Data.

Trial Presentation of Material

Purpose of the trial recordings.--Trial recordings were made in order to: (1) establish a recording procedure; (2) determine the types of musical material to be used in the study; and (3) master the mechanics of the recording apparatus.

Subjects used.--A group of fifteen pupils, chosen from the primary grades of a neighboring school, was used in making the trial recordings. Five pupils were selected from the singing groups in each grade. All types of the material used in making the final recordings were used with this experimental group. In addition to this group, a second experimental group was selected from the seventh and eighth grades of the junior high school. This group numbered ten boys and eight girls. All were volunteers chosen at random from a rather large number of pupils all of whom thought it would be fun to make the recordings.

Results obtained from the trial presentation.--The results of the trial presentations with elementary school pupils are presented in the following paragraphs.

1. Not all of the pupils in any one grade were equally familiar with the songs chosen for recording. It was then decided to permit them to sing any familiar song taught by the school music teacher and to record their efforts at doing so. Since the study did not have as its purpose the establishing of norms of achievement for any grade, it was not considered important that all pupils be made to perform the same songs. Where they could they were asked to do so. Only a few

exceptions occurred in the final recordings.

2. It was found to be impossible to maintain good attention and to obtain the best effort when the pupils were asked to record their responses in terms of both tonality and tonal memory during one recording period. The minimum time necessary to record all of the material was found to be seventeen minutes for pupils in the third grade and twenty-four minutes for the pupils in the first grade. Since the material was of such a nature as to demand undivided attention for the pupils to hear the dictated material and to respond to it as accurately as possible, this amount of time was judged to be considerably too long to obtain best results.

3. The tonal groups which were at first used were found to be too numerous for the elementary-school pupils. The first trial of this material used forty tonal groups arranged as follows: ten three-tone groups; ten four-tone groups; ten five-tone groups; and ten six-tone groups. Inasmuch as the three-tone groups presented no problem but yet consumed time and contributed to poor attention, it was decided to eliminate them in the final presentation of this material. The number of groups were likewise reduced from ten to five for each series.

4. From an analysis of the trial recordings, it was found to make no appreciable difference whether the tonal groups were dictated beginning with the four-tone groups and proceeding to the six-tone groups or vice-versa. Using tonal groups similar in difficulty, two recordings were made of each pupil in the trial groups in the elementary-grades. The first recording was made by dictating the four-tone groups and then proceeding to the five- and six-tone groups. The second recording was made

using the opposite procedure with similar tone groups. The practice acquired through singing the four- and five-tone groups first seemed to help the pupil in singing the six-tone groups, as a little better score was made by the pupils on the six-tone series when presented last than when presented first.

5. Recordings made by the junior high school pupils did not contribute anything in particular to a furtherance of the study or cause any change in the adopted recording procedure. The recordings did offer an opportunity to gain facility in the recording process, and some interesting phenomena were observed of a nature different from the data desired for this study.

Procedures Used in Obtaining the Data

From the experience gained in making the trial recordings, definite procedures were established to obtain the recordings of the subjects. These procedures were related to the interest of the investigation in tonality apprehension and tonal memory. After the procedure for each phase had been decided upon, it was adhered to strictly.

Procedure adopted to obtain data on the apprehension of tonality.--A conference was held with the music instructor for the purpose of choosing the songs to be recorded. The songs which had been taught to these pupils were studied and analyzed and the most familiar were chosen for recording. For the first grade, "The Kangaroo,"¹ "The Baker,"²

¹Mabelle Glenn, Helen S. Leavitt, and Victor Rebman, Sing a Song, p. 42. Boston: Ginn and Company, 1936.

²Ibid., p. 11.

and "Away In A Manger",³; for the second grade, "Dinky Donkey",⁴ "America",⁵ "Away In A Manger",⁶ and "The Grasshopper"⁷; and for the third grade, "Fairy Fiddles",⁸ "The Organ Man",⁹ and "The Echo".¹⁰ Four songs were necessary for the second grade because the same songs were not familiar to both classes comprising this grade.

Copies of these songs are presented in Appendix A.

In order to obtain the recordings of these songs each class was visited several days in advance of the date when the individual recordings were begun and an explanation was made to the pupils as to what was expected of them when they came individually to make their recording. While visiting with the class, the recording apparatus was assembled and the class was asked to make a recording of a song with which they were familiar. The class was permitted to choose the song which they wished to record. After having once sung it through, they

³Martin Luther, Christmas Carols Around the World, p. 18. New York: G. Schirmer, Inc., 1928.

⁴Mabelle Glenn and others, Listen and Sing, p. 23. Boston: Ginn and Company, 1936.

⁵Ibid., p. 138.

⁶Martin Luther, op. cit., p. 18.

⁷Mabelle Glenn and others, Tuning Up, p. 137. Boston: Ginn and Company, 1936.

⁸Ibid., p. 15.

⁹Ibid., p. 38.

¹⁰Ibid., p. 11.

were given the starting tone and the recording was made. Following the making of the record, it was immediately played back to them. This procedure served as an excellent motivating device.

On the day assigned to a particular class for the cutting of individual records, the room teacher was asked to send her pupils individually to the recording room at intervals of ten minutes.

Each child came into the room by himself and was again made acquainted with the recording apparatus. He was then told what was to be done. The child was placed close to the microphone and the following directions given to him: "You will be asked to sing three songs which have been taught to you by your music teacher. The starting tone of the first song will be given to you and you may sing the song once for practice." If the child was not familiar with the suggested song, he was asked to sing another song from the group chosen for his grade. After the song had been practiced, the directions were continued. "You will now be given the starting tone of the same song, and when the signal to begin is given to you, you may begin to sing the song again. Be careful to look right into the microphone as you sing." The beginning signal was a lowering of the right arm by the operator. The tone and volume controls on the recorder had been set during the practicing of the song.

Upon the completion of the recording of the first song, the child was then told, "You may now practice the second song, and this is the starting tone for it." After the song had been practiced, the child was then given the same directions as were used in recording the first song. The recording of the third song was accomplished in the same manner.

Procedure Used to Obtain Data on Tonal Memory

Groups used.--It was the plan of the investigation to study tonal memory in two ways: (1) as it was revealed by the ability to sing familiar songs; and (2) as it was revealed by the ability to repeat a series of tone groups and a musical phrase after one hearing. For the first method, the recordings obtained for the purpose of studying tonality apprehension were felt to be sufficient and the recordings of all of the pupils were used. For the second method, recordings were obtained only from the singer group in each grade. These children comprised the membership of the primary-grade choir, and had been selected by the music teacher for this organization on the basis of their ability to sing a familiar song used as a test. This group numbered sixty-four out of the 135 children in the entire study, but only fifteen first-, twenty-two second-, and twenty-one third-grade pupils were available at the time the records were made.

The pupils of the singer-group were used for this phase of the investigation because they were the only ones who had the vocal ability to perform the dictated materials. The data derived from a special test of tonal memory which demands the ability to repeat dictated materials vocally would be practically meaningless if the test were given to pupils who could not vocally perform the materials--that is, in order to sing a series of tone groups from memory, pupils must first of all have the vocal ability required for their performance.

Recording the data on the tone groups.--The pupils were sent to the recording room individually by their classroom teacher at intervals of fifteen minutes. The teacher had a list of the pupils

who were desired. The order of sending them was left to the teacher's decision.

When the pupil entered the room he was told: "You will hear a group of tones sung to you which you will want to listen to very carefully so that after you have heard them, you may repeat them just as you remember them. We will now try some just for practice." Two practice groups for each series were dictated vocally, viz., two for the four-tone series, two for the five-tone series, and two for the six-tone series. After the practice groups had been dictated and the child's response elicited, the child was told: "Now we are ready to begin to record each group of tones. Remember to listen well to each group of tones and then try hard to sing them just as you heard them." After these instructions, a starting pitch was obtained from the piano and the investigator sang the first group of the four-tone series. He then recorded the child's response. This procedure continued until all of the four-tone groups had been dictated, following which the five- and six-tone groups were dictated. A short rest period and two practice groups intervened between each series.

In order to keep the time span and the rhythm constant for all pupils, a metronome was used during the dictation. The tempo established for the speed of dictation of the tone groups was: for the four- and five-tone groups $\downarrow = 63$; for the six-tone groups, $\downarrow = 80$. The two speeds were used in order to insure a minimum of variation in time span between the shorter and the longer groups.

To facilitate the recording and the analysis of the responses, it was found to be advisable to record both the dictation and

the response.

A manuscript copy of the tone groups is presented in Appendix B.

Recording the data on phrase memory.--The procedure used in recording the data on phrase memory was similar to that used in recording the data on tone groups. The same pupils were used and similar directions were given.

Before the recordings were made, each child was given an opportunity to practice on two phrases which, in melodic and rhythmic construction, resembled that which was used for his recording. Following the practice period, the test phrase was dictated once and the child's response was recorded. The phrase was dictated at the metronome speed of $\text{♩} = 76$. A manuscript copy of the test phrase is shown in Appendix B.

Treatment of Data

The use of graphs.--The recordings made by the children were transcribed to graphs which indicated, in terms of diatonic semitones, the design of the melodies of the songs and of the dictated tonal materials. The data, derived from a comparison of the design of the pupils' response with the design of the test materials, were treated statistically and are presented in succeeding chapters in the form of tables and figures.

Summary

Thirty-nine first-, fifty second-, and forty-six third-grade pupils were used as subjects in an investigation of the tonality

apprehension and tonal memory of primary-grade children. A study was made of their community background and of the course of study in music in force in the school from which the subjects were selected. Testing material was chosen from the song literature with which they were familiar. Three series of tone groups and a musical phrase were developed from the songs contained in the music texts used for these grades. By the use of an instantaneous recorder and an electric metronome, the testing material was given a trial presentation with fifteen primary-grade pupils of a nearby elementary school and with ten boys and eight girls from the seventh and eighth grades of the junior high school in the same community. The results of the trial presentation indicated that it was not essential that each child perform the same songs; that the tonal groups were too numerous; and that the order of dictating the tone groups was of little importance. Facility in the handling of the recording apparatus was a major gain of the trial presentation.

Following a final selection of material, the recordings of the subjects were begun. These were made individually, and began with the recording of songs. Upon entrance into the recording room, each child was told specifically what was to be done and his recording followed a set pattern. A similar procedure was followed in recording the material to test tonal memory. An electric metronome was used to keep the dictation speed of the tonal materials constant for each child.

After the collection of the raw data the responses of the subjects were transcribed on specially constructed graphs which showed both the design of the original material and the pupils' response. These graphs were analyzed, and the data obtained treated statistically for the

purpose of answering the questions posed by the problem.

Succeeding chapters will present the data obtained by the recording procedures. The chapter immediately following will be concerned primarily with the data on tonality apprehension.

CHAPTER IV

ANALYSIS OF DATA ON TONALITY APPREHENSION

Introduction

This chapter presents the data on the tonality apprehension of the 135 primary-grade children who served as subjects. The data are presented and discussed in five major sections of the chapter.

(1) The pupils are classified in terms of their ability to establish and maintain tonality throughout the singing of familiar songs. (2) The relationship is shown between tonality apprehension and chronological age and between tonality apprehension and grade placement. (3) Several types of tonal errors are studied. (4) The relationship is shown between the melodic content of the songs, and the problem of tonality apprehension. (5) The final section shows the effect on performance of lowering the pitch of songs for thirty pupils who experienced difficulty with vocal production.

Types of data.--The treatment of the data varies according to the section of the chapter. In the first section data are presented showing the distribution of the subjects as a whole and by separate grades for general ability in tonality apprehension. Three categories are set up, and the classification is in terms of these categories.

In the section on the relationships between chronological age and tonality apprehension and between grade placement and tonality apprehension, the data are presented in terms of coefficients of contingency.

The data on the characteristic tonal errors show the

types of errors which these children made in the singing of familiar songs and the influence which these types of errors had on their ability to establish and maintain tonality.

The evidence on the relationship of melodic content to the problem of tonality apprehension is of two types. The first shows the relationship of the intervals of the songs to the problem of tonality and the second shows the relationship of song range and pitch level to tonality.

An analysis of the charts of thirty pupils who experienced difficulty with vocal production shows the effect of lowering the pitch of the songs on their singing.

Purpose.--The chapter has as its purpose the answering of certain specific questions relative to tonality apprehension which may assist primary-grade music teachers in the organization of music groups, the selection of material, and its presentation. The questions are:

1. How is ability with respect to tonality apprehension distributed in the primary-grade pupils studied?
2. Do the older pupils have more ability than younger ones?
3. Do the pupils of the third grade have more ability than those of the second grade, and the second-grade pupils more than the pupils of the first grade?
4. What types of errors are made by the pupils of these grades, and what effect do they have on tonality?
5. Does the interval content of song material have any bearing on a pupil's ability to establish and maintain tonality?
6. Do the range and pitch level of song material have

any effect on the maintenance of tonality?

7. What intervals are missed most frequently by the pupils of the primary grades?

8. What melodic structure is best suited to the ability of primary-grade pupils?

9. What effect does the lowering of the pitch of a song have upon the ability of a pupil who experiences difficulty with vocal production?

Distribution of Ability

Classification of pupils.--The classification of pupils in terms of their ability in tonality apprehension involved two steps: (1) the transcribing of their recorded responses on specially constructed graphs arranged to show the correct melodic line and the response of the pupil, and (2) a study of the graphs for the purpose of determining each pupil's ability by comparing his response with the correct melody.

The transcription procedure involved finding the pitch level of the various tones of each pupil's response by finding the corresponding tones on a piano tuned to A-440, the basic pitch of the piano used in the testing situation. Each transcription was checked at least twice in the same manner. Additional checking was found to be necessary for those pupils who were weak in tonality.

Classes of ability with respect to tonality apprehension.--A study of the graphs revealed that three categories or groups of tonal ability could be distinguished. These may be defined as follows in descending order of ability:

Group I. Pupils who established a key tonality and maintained this tonality throughout the singing of the song.

Group II. Pupils who established a key tonality but did not maintain the adopted tonality throughout the singing of the song.

Group III. Pupils who did not establish or maintain a key tonality.

Figures 5 to 7 are illustrations of each of the three groups. In Figure 5 there is evidence of a high degree of accuracy, and the establishment and maintenance of tonality throughout the child's singing. The child whose singing is represented by Figure 6 established tonality, but failed to maintain it throughout the singing of the song. The third child, whose chart is shown by Figure 7, failed either to establish or to maintain tonality.

General principles of classification.--Thirty-nine first-grade pupils recorded one or more of three songs chosen for this grade. Their classification was based upon the performance of "The Kangaroo" by twenty-nine pupils, "Away In A Manger" for eight, and "The Baker" for two. The use of "The Kangaroo" for the purpose of classifying those pupils who had sung it was decided upon because of its frequency of performance. The use of "Away In A Manger" for the purpose of classifying those pupils who had not sung "The Kangaroo" was decided upon because it ranked second in frequency of performance and also because it offered more opportunities for the study of tonality difficulties than did "The Baker".

Fifty second-grade pupils recorded one or more of the four songs chosen for this grade. Classification was based upon the singing

of "Dinky Donkey" for thirty-nine pupils, "The Grasshopper" for nine pupils, and "America" and "Away In A Manger," for one pupil each. The use of the songs "Dinky Donkey" and "The Grasshopper" for the final classification was based upon their frequency of performance, and upon the fact that they are more typical of second-grade song literature than the other songs.

The third-grade pupils were asked to sing three songs, "The Organ Man", "Fairy Fiddles", and "The Echo". Their classification was derived from the performance of "The Organ Man", because it was performed by all of the pupils in this grade. This choice thus simplified the problem of comparison.

Results of classification.--Tables II and III show the number and per cent of pupils in each grade in each of the three ability groups. They show:

1. The greatest percentage of pupils in the first group is in the second grade. This is contrary to the usual expectation, and may be due to two factors: first, the second grade songs chosen for the basis of classification may not have been so difficult as those performed by the first and third grades, and second, the difference may be due to chance factors.

2. The proportion of pupils in Group III decreases from the first to the third grade. This would seem to indicate a refinement of ability as the pupils progress from one grade to another.

Relationship Between Chronological Age, Grade Placement and Tonality Apprehension

Relationship between chronological age and tonality apprehension.--In order to study the relationship between chronological

TABLE II
DISTRIBUTION OF SUBJECTS WITH RESPECT
TO TONALITY APPREHENSION: FREQUENCIES

Ability Groups	First Grade	Second Grade	Third Grade	Total
Group I	11	26	16	53
Group II	12	12	21	45
Group III	16	12	9	37
Total	39	50	46	135

TABLE III
 DISTRIBUTION OF SUBJECTS WITH RESPECT
 TO TONALITY APPREHENSION: PERCENTAGES

Ability Groups	First Grade	Second Grade	Third Grade	All Grades
Group I	28	52	35	39
Group II	31	24	46	33
Group III	41	24	19	27
Total	100	100	100	99

age and tonality apprehension, a table (Table IV) was constructed in which the 135 pupils were classified by age and ability. Included with the children in the seventy-three to eighty months age interval was one child whose age was seventy-two months.

The coefficient of mean square contingency was computed to determine the relationship. The formula, as given by Garrett¹, is $C = \sqrt{\frac{P-1}{P}}$. By this formula, C equals .30, a figure which indicates little significant relationship between chronological age and tonality apprehension.

The test of significance used for this and subsequent coefficients of mean square contingency, as given by Garrett², is $\sigma_c = \frac{1}{N}$. The criterion of significance demands that C equal four times σ_c in a test of the null hypothesis.

Relationship between grade placement and tonality apprehension.---Table V shows the relationship between grade level and ability.

The coefficient of contingency is .27. This figure shows the existence of a small significant relationship between grade placement and tonality apprehension.

Table IV and V reveal extensive overlapping in ability from one age or grade to another in the primary grades. On the basis

¹H. E. Garrett, Statistics in Psychology and Education, p. 201. New York: Longmans, Green and Co., 1933.

²H. E. Garrett, Statistics in Psychology and Education, p. 359. New York: Longmans, Green and Co., 1947.

TABLE IV
 DATA FOR COMPUTATION OF COEFFICIENT OF CONTINGENCY
 FOR CHRONOLOGICAL AGE AND TONALITY APPREHENSION

Age Groups	Ability Groups			Total
	Group I	Group II	Group III	
105.- 112	8	11	5	24
97 - 104	14	11	5	30
89 - 96	18	6	9	33
81 - 88	7	10	9	26
73 - 80	6	7	9	22
Total	53	45	37	135
			P	1.0991
			C	.36

TABLE V
 DATA FOR COMPUTATION OF COEFFICIENT OF CONTINGENCY
 FOR GRADE LEVEL AND TONALITY APPREHENSION

Grade Groups	Ability Groups			Total
	Group I	Group II	Group III	
Grade One	11	12	16	39
Grade Two	26	12	12	50
Grade Three	16	21	9	46
Total	53	45	37	135
			P	1.0784
			C	.27

of these data, a teacher of music in these grades may expect to find pupils of very immature ability with respect to tonality apprehension and also those who possess this ability to a marked degree. This would be especially true in situations where little or nothing is done for the training of tonality consciousness.

Characteristic Types of Errors

Method of determining the types of errors.--The performance charts of the thirty-nine first-grade, fifty second-grade and forty-six third-grade pupils used as the subjects of this study were analyzed to determine what types of errors were made by them while singing familiar songs. The charts were further studied to determine what effect these various types of errors had upon their ability to establish and maintain a key tonality.

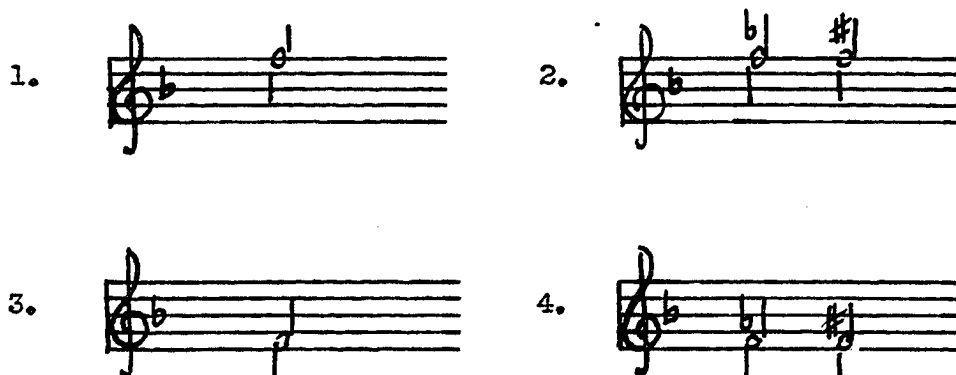
Types of errors.--From the analysis of the performance charts it was determined that five types of errors were made: errors of intonation; errors of pitch on intervals and repeated tones; errors which resulted from the repetition of melodic motives out of correct order; errors which resulted from the invention of new melodic material; and errors which were made by the omission of tones.

Types of Intonation Errors.--Intonation errors were of six types: singing flat or sharp on the beginning tones, on the highest tones, on the lowest tones, on ascending intervals, or on descending intervals, and changing intonation on repeated tones. For purposes of calculation, each intonation error was classified in one category only.

Method of scoring intonation errors.--One intonation error was scored when a pupil sang the beginning tone or lowest tone of the song either sharp or flat from the pitch indicated for it by the key tonality of the song. For example, when "The Organ Man" is sung in the key of F, the beginning tone is one line octave F. Should a pupil sing this tone either sharp or flat at this pitch he would be scored with an error. The same would be true for the highest and lowest tones, which in this song are two line octave F and one line octave F, respectively. Errors made on the highest tones could also have been considered as errors on ascending intervals, since the highest tones in these songs were approached by such intervals. However, they were scored only as errors on the highest tones.

Figure 8 illustrates correct and incorrect pupil responses on the highest, lowest, and beginning tones of the song. In this song the beginning tone and the lowest tones are identical. In these illustrations, the correct pitch is indicated by notes the stems of which point upward, and the pupil's response is shown by notes with the stems pointing downward. The accidental signs above the notes of the incorrect responses show the direction of the error.

Errors on ascending and descending intervals were scored for those pupils who sang either or both kinds of interval flat or sharp at the indicated pitch for the key tonality in use. For example: in the song mentioned above, the first two tones are one line octave F and one line octave A. Should a pupil sing the first tone with correct intonation, and the second tone with incorrect intonation, an error would be scored against him on an ascending interval. Errors on descending intervals would be scored in a similar way. Figure 9 shows



- Key:**
1. Correct pupil response on the highest tone.
 2. Incorrect pupil response on the highest tone.
 3. Correct pupil response on the lowest and beginning tone.
 4. Incorrect pupil response on the lowest and beginning tone.

Notes with stems pointing up show the correct pitch. Notes with stems pointing down show pupil performance. A flat (b) or a sharp (#) above a note indicates that the tone was sung flat or sharp at the pitch level shown.

Figure 8.--Illustrations of Correct and Incorrect pupil Responses with Regard to Intonation on the Highest, Lowest, and Beginning Tones of "The Organ Man."



- Key:
1. Correct pupil response on an ascending interval.
 2. Incorrect pupil response on an ascending interval.
 3. Correct pupil response on a descending interval.
 4. Incorrect pupil response on a descending interval.

Notes with stems pointing up show the correct pitch. Notes with stems pointing down show pupil performance. A flat (*b*) or a sharp (*#*) above a note indicates that the tone was sung flat or sharp at the pitch level shown.

Figure 9.--Illustrations of Correct and Incorrect Pupil Responses with Regard to Intonation on Ascending and Descending Intervals.

illustrations of correct and incorrect responses on ascending and descending intervals.

Errors were recorded on repeated tones when the repetition of a tone differed in intonation from the tone which was to be repeated. For example, in the same song, tones three, four, and five are all two line octave C in the tonality of F. Should a pupil sing the first of these at the correct pitch and the second tone sharp or flat from it, an error would be scored against him. However, should he sing the first of these tones flat and the second and third tones in the same manner, no error would be scored against him. Figure 10 presents illustrations of correct and incorrect pupil responses on repeated tones.

Distribution of intonation errors.--Table VI shows the distribution of intonation errors made by the subjects. The data are presented both for the entire group of subjects and for the sub-groups classified in terms of ability in tonality apprehension, as noted earlier in this chapter. (page 67). The findings of this table are summarized in the following paragraphs.

1. Intonation errors are more likely to occur in all ability groups on ascending intervals than on any other type of tonal pattern. Of the 226 errors 38 per cent were made by singing the ascending intervals flat, and 6 per cent were made by singing them sharp. These percentages, when added to those for the errors made on the highest tones, which in all songs were approached by an ascending interval, account for 61 per cent of all the intonation errors made.

2. Occasional intonation errors made by primary-grade pupils



- Key: 1. Correct pupil response.
 2. Correct pupil response.
 3. Correct pupil response.
 4. Incorrect pupil response showing two errors.
 5. Incorrect pupil response showing one error.
 6. Incorrect pupil response showing one error.

Notes with stems pointing up show the correct pitch. Notes with stems pointing down show pupil performance. A flat (*b*) or a sharp (*#*) above a note indicates that the tone was sung flat or sharp at the pitch level shown.

Figure 10.--Illustrations of Correct and Incorrect Pupil Responses with Regard to Intonation on Repeated Tones.

TABLE VI
DISTRIBUTION OF INTONATION ERRORS MADE BY
PRIMARY-GRADE PUPILS CLASSIFIED INTO THREE ABILITY GROUPS

Types of Errors	Ability Groups			Total Errors	Per Cent
	Group I	Group II	Group III		
Beginning Tone					
Sharp	2	4		6	3
Flat	7	4	1	15	7
Highest Tone					
Sharp	5	3		8	3
Flat	21	10	1	32	14
Lowest Tone					
Sharp	3			3	1
Flat	6	6		12	5
Ascending Interval					
Sharp	6	8		14	6
Flat	40	40	5	85	38
Descending Interval					
Sharp	6	11	5	22	10
Flat	11	8	1	20	9
Repeated Tones					
Sharp	2			2	1
Flat	4	2	1	7	3
Total Errors	113	99	14	226	100
Number of Pupils In each Group	53	45	37	135	100
Number of Pupils Making Errors	34	31	6	71	53

who have ability to establish a key tonality in the singing of familiar songs have little effect on their ability to maintain tonality. A study of the performance charts of the thirty-four Group I and thirty-one Group II pupils showed that in spite of the 212 intonation errors made by them, only three lost tonality due to such errors.

3. Few of the subjects made intonation errors on repeated tones. Only nine of the 226 errors made were of this type.

4. A study of the performance charts of the thirty-seven pupils who failed to establish tonality showed that the intonation errors made by them had little to do with this failure. That so few intonation errors were scored for this group of pupils is accounted for by the fact that they strayed so far from the correct melody that only a few errors could be classified as intonation errors.

Intonation errors that most affect the maintenance of tonality.--An examination of the performance charts of the three pupils who lost tonality because of intonation errors showed that in each case, tonality was lost because of faulty intonation in the singing of ascending intervals. The singing of the second tone of such an interval resulted in a change of tonality, generally to a key one semi-tone lower.

Pitch Errors

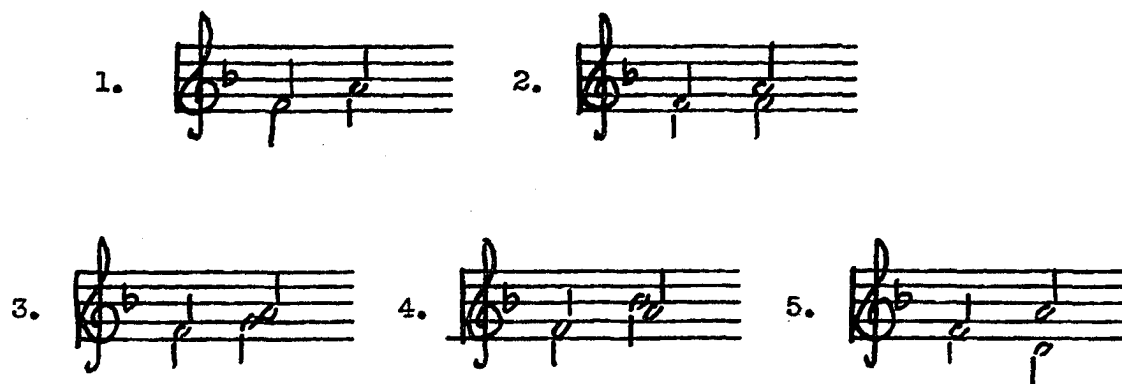
Types of pitch errors.--Pitch errors made by the pupils of the three grades studied were of two types. Errors of the first type resulted from the pupils not maintaining the correct tonal relationship between the tones of the intervals of the songs, while those of the second type resulted from changing pitch while singing repeated tones.

Method of scoring pitch errors related to ascending and descending intervals.--In scoring pitch errors related to intervals, an error was recorded for a pupil each time he failed to sing tones having the same tonal relationship as the indicated interval required.

An analysis of the performance charts revealed that four types of pitch errors were made by these pupils in relation to their singing both ascending and descending intervals. These were: a smaller interval was sung; a larger interval was sung; one or more tones were repeated; an interval was sung in the opposite direction from that indicated. For example, the first two tones of "The Organ Man" comprise an ascending interval of a major third. Should a pupil sing an interval smaller than a major third the error recorded for him would be singing too small an ascending interval. Should this interval be produced as a fourth or fifth, an error would be recorded for singing too large an ascending interval. Should the first tone of the interval be repeated, an error would be scored for an ascending interval sung as repeated tones. It would be recorded as an ascending interval sung in the opposite direction if a pupil sang a descending interval instead.

Figure 11 illustrates these types of errors in relation to the ascending interval mentioned above. In these and the following illustrations, notes with stems pointing down indicate the pupil performance.

Method of scoring pitch errors on repeated tones.--Errors of pitch on repeated tones were scored for those pupils who failed to sing indicated repeated tones at the same pitch level. For example, should a pupil sing tones four or five of the song mentioned above at



Key: 1. Correct response.

2. Repeated tone on an ascending interval.

3. An ascending interval sung too small.

4. An ascending interval sung too large.

5. An ascending interval sung in the opposite direction.

(Notes with stems pointing up show the correct pitch. Notes with stems pointing down show pupil performance.)

Figure 11.--Illustrations of Pitch Errors made on an Ascending Interval.

any other pitch level than that indicated for tone three, which is the first of a series of three repeated tones on C of the two line octave, he would be scored with an error of this type.

Figure 12 shows illustrations of correct and incorrect pupil responses on repeated tones.

Distribution of pitch errors on intervals and repeated tones.--Table VII shows the distribution of pitch errors made by all subjects, classified with respect to tonality apprehension into three ability groups on the basis of their performance of a particular song for each grade. Errors made by the singing of ascending and descending intervals too small constituted 39 percent of the total errors made. These data indicate a definite weakness in pitch relationship.

Classification of ability considering performance on all songs.-- A further analysis of the performance charts served as the basis for a regrouping of the children giving consideration to their performance on all songs sung by them. Table VIII shows the number of pupils who: (1) maintained tonality on all songs; (2) established but lost tonality on one or more songs; and (3) failed to establish tonality on one or more songs. To be in the first category a pupil must have established and maintained tonality on all songs sung by him. If on one song he maintained tonality but on a second song lost tonality after having established tonality, he would be placed in the second category. He would be placed in the third category if on one song he failed to establish tonality, regardless of what he had done on other songs.

Pitch errors made by the pupils who maintained tonality on all songs sung by them.--According to Table VIII, thirty-five pupils maintained tonality on all songs sung by them. Table IX shows the distribution of pitch errors made by these pupils. Conclusions may be stated as follows:

1. The largest number of errors was made by singing the



Key: 1. Correct response.

2. Incorrect response.

3. Incorrect response.

(Notes with stems pointing up show the correct pitch. Notes with stems pointing down show pupil performance.)

Figure 12.—Illustrations of Correct and Incorrect Pupil Responses on Repeated Tones.

TABLE VII

DISTRIBUTION OF PITCH ERRORS MADE BY 135
PRIMARY-GRADE PUPILS CLASSIFIED INTO THREE
ABILITY GROUPS ON TONALITY APPREHENSION

Types of Errors	Ability Groups			Total Errors	Per Cent
	Group I	Group II	Group III		
Ascending Intervals					
Repeated tones	21	30	58	109	6
Too small	50	171	167	388	20
Too large	31	40	81	152	8
Opposite direction	19	38	125	182	9
Descending Intervals					
Repeated tones	39	39	68	146	7
Too small	57	144	176	377	19
Too large	25	98	115	238	12
Opposite direction	11	32	116	159	8
Change of Pitch on Repeated tones	16	51	152	219	11
Total Errors	269	643	1058	1970	100
Number of Pupils In Each Group	53	45	37	135	
Number of Pupils Making Errors	44	45	37	126	

TABLE VIII
NUMBER AND PERCENTAGE OF PUPILS WHO
MAINTAINED, LOST, OR FAILED TO ESTABLISH
TONALITY ON ONE OR MORE SONGS

Categories	Total	Per Cent
Maintained tonality on all songs	35	26
Established but lost tonality on one or more songs	58	43
Failed to establish tonality on one or more songs	42	31
Total	135	100

TABLE IX
 DISTRIBUTION OF PITCH ERRORS MADE BY
 PRIMARY-GRADE PUPILS WHO MAINTAINED
 TONALITY ON ALL SONGS SUNG BY THEM

Types of Errors	Grade One	Grade Two	Grade Three	Total Errors	Per Cent
Ascending Intervals					
Repeated tones	9	5	2	16	10
Too small	12	13	6	31	19
Too large	6	9	2	17	10
Opposite direction	6	6	2	14	9
Descending Intervals					
Repeated tones	9	18	1	28	16
Too small	12	14	6	32	19
Too large	5	6		11	5
Opposite direction	3	3	1	7	4
Change of Pitch on Repeated Tones	2	8	3	13	7
<u>Total Errors</u>	64	82	23	169	99
<u>Number of Pupils who Maintained Tonality</u>	10	18	7	35	
<u>Number of Pupils Making Errors</u>	9	14	3	26	
<u>Number of Performances</u>	18	37	21	76	
<u>Average Number of Errors per Performance</u>	3.6	2.2	1.0	2.2	

ascending and descending intervals too small.

2. On the basis of the average number of errors per performance, there is a development in precision of singing from the first grade through the third grade. This seems to be in conflict with the data presented earlier, which indicated little relationship between grade placement and tonality apprehension. This discrepancy is more apparent than real. The relationship earlier computed for grade placement and tonality apprehension took into account all the subjects of the study, and showed that in each grade there are pupils in each category of general tonal ability. In Table IX the data are derived wholly from the records of the thirty-five pupils who maintained tonality. Within this superior group there is a definite progression in quality of performance from the first grade to the third.

Pitch errors made by the pupils who failed to maintain tonality on all songs sung by them.--Table X shows the number of song performances on which tonality was lost by the fifty-eight pupils who lost tonality on one or more songs because of pitch or intonation errors. It shows that thirty-five pupils lost tonality in the singing of only one song, seventeen lost tonality on each of two songs, and six on each of three songs. Of the thirty-five pupils who lost tonality on one song, thirty-four lost tonality because of pitch errors and one because of intonation errors. Of the seventeen pupils who lost tonality on each of two songs, sixteen lost tonality on both songs because of pitch errors. One of these pupils lost tonality on one song because of pitch errors and on a second song because of intonation errors. Of the six pupils who lost tonality on each of three songs, five did so because of pitch errors, and one because of pitch errors on two songs and intonation

TABLE X
 NUMBER OF PERFORMANCES ON WHICH
 TONALITY WAS LOST BY FIFTY-EIGHT PUPILS
 BECAUSE OF PITCH AND INTONATION ERRORS

Cause of Loss of Tonality	Performance			Total
	On One Song	On Two Songs	On Three Songs	
Pitch Errors	34	33	17	84
Intonation Errors	1	1	1	3
Total Performances	35	34	18	87
Number of Pupils	35	17	6	58

errors on the third song. Thus tonality was lost in 87 performances. The loss of tonality was due to pitch errors in 84 performances, and to intonation errors in 3 performances.

Table XI shows the types of pitch errors which caused the loss of tonality for the 84 performances in which this loss was due to pitch errors. It shows that the pitch errors made by singing ascending intervals too small caused the loss of tonality in as many performances as all the other types of pitch errors combined. It is important therefore to stress the pitch relationship that exists between the tones of these intervals in order to correct the tendency to sing them too small.

Table XII shows the distribution by grades of all pitch errors which these pupils made in singing the songs on which tonality was lost. It shows that the largest average number of errors per performance was made by the first-grade pupils. The figures given for the average number of errors per performance for the second and third grades indicate little or no improvement in the ability to maintain tonality after the second grade in a situation where specific training in this ability is not stressed.

Pitch errors made by pupils who failed to establish tonality on all songs sung by them.—Forty-two pupils failed to establish tonality on all songs sung by them. Table XIII shows the distribution of pitch errors made while singing the songs for which they failed to establish tonality. It reveals that the largest average number of errors per performance was made by the first-grade pupils. Like Table XII it also shows little or no improvement in performance from the second to the third grades.

A study of the charts of the forty-two children who failed to establish tonality on one or more songs sung by them showed the causes for this condition as indicated by the types of errors which they made.

TABLE XI

DISTRIBUTION OF TYPES OF PITCH ERRORS WHICH
CAUSED THE LOSS OF TONALITY WITH PUPILS WHO LOST
TONALITY ON ONE, TWO, OR THREE PERFORMANCES

Types of Errors	Performance			Total	Per Cent
	On One Song	On Two Songs	On Three Songs		
Ascending Intervals					
Repeated tones			1	1	1
Too small	19	16	7	42	50
Too large		1	1	2	2
Opposite direction					
Descending Intervals					
Repeated tones	2	2		4	5
Too small	6	4	2	12	14
Too large	4	2	2	8	10
Opposite direction	1			1	1
Change of Pitch on Repeated Tones	1	2	3	6	7
Combination of Types					
Ascending and Descending Intervals too small	1	3		4	5
Ascending and Descending Intervals too large		1		1	1
Ascending Intervals too small and Descending ones too large		1		1	1
Ascending and Descending Intervals sung in the Opposite Direction			1	1	1
Repeated Tones on Intervals		1		1	1
Total Performances	31*	33*	17*	84	99
Number of Pupils	35	17	6	58	

*One pupil in each group lost tonality on one song because of intonation errors.

TABLE XII

DISTRIBUTION OF PITCH ERRORS MADE ON THE SONGS
ON WHICH TONALITY WAS LOST BY THE PUPILS WHO
FAILED TO MAINTAIN TONALITY ON ALL SONGS SUNG BY THEM

<u>Types of Errors</u>	<u>Grade One</u>	<u>Grade Two</u>	<u>Grade Three</u>	<u>Total</u>	<u>Per Cent</u>
Ascending Intervals					
Repeated tones	19	3	8	30	5
Too small	38	43	84	165	27
Too large	12	12	12	36	6
Opposite direction	12	4	21	37	6
Descending Intervals					
Repeated tones	11	15	12	38	6
Too small	35	28	76	139	22
Too large	22	28	41	91	15
Opposite direction	6	5	19	30	5
Change of pitch on					
Repeated tones	10	5	35	50	8
Total Errors	165	143	308	616	100
Number of Pupils	13	20	25	58	
Number of Performances	16	27	44	87	
Average Errors per Performance	10.3	5.3	7.0	7.1	

TABLE XIII

DISTRIBUTION OF PITCH ERRORS MADE ON THE SONGS
ON WHICH TONALITY WAS NOT ESTABLISHED BY THE PUPILS
WHO FAILED TO ESTABLISH TONALITY ON ALL SONGS SUNG BY THEM

Types of Errors	Grade One	Grade Two	Grade Three	Total	Per Cent
Ascending Intervals					
Repeated tones	39	14	5	58	6
Too small	46	30	83	159	16
Too large	46	17	15	78	8
Opposite direction	39	29	47	115	11
Descending Intervals					
Repeated tones	36	16	13	65	7
Too small	48	37	76	161	16
Too large	50	21	43	114	11
Opposite direction	37	19	51	107	11
Change of pitch on Repeated tones	35	11	98	144	14
Total Errors	376	194	431	1001	100
Number of Pupils	16	12	14	42	
Number of Performances	16	13	24	53	
Average Errors per Performance	23.5	14.9	18.0	18.9	

Errors made by repeating tones where intervals were indicated, and by singing intervals in the opposite direction, revealed a weakness in sense of direction. Errors made by singing intervals too large or too small revealed a weakness in pitch relationship. Errors made by changing pitch on repeated tones showed that the subjects were unstable in the maintenance of pitch.

Table XIV shows the number of pupils who failed to establish tonality because of the operation of each type and combination of types of tonal weakness. It shows the largest percentage of the pupils in this group as being unable to establish tonality because of a weak sense of direction combined with a weak sense of pitch relationship. Poor sense of pitch relationship was the most prevalent single type of tonal weakness.

Summary of the data on pitch errors.—The data on pitch errors, which have been presented in this section, may be summarized as follows:

1. Pitch errors have a direct bearing on a primary-grade pupil's ability to establish and maintain tonality. This is indicated by the data in Table X which shows that in 84 performances out of 87 in which children lost tonality they did so because of pitch errors. Table XIV offers evidence to support the contention that failure to establish tonality is primarily due to poor pitch consciousness.

2. The one type of tonal pattern which causes the most difficulty in establishing and maintaining tonality is the ascending interval. Table XI shows this for the pupils who lost tonality, and a study of the charts of the pupils enumerated in Table XIII shows evidence of this for those who failed to establish tonality.

TABLE XIV

DISTRIBUTION OF TYPES OF TONAL WEAKNESS WITH
PUPILS WHO FAILED TO ESTABLISH TONALITY

Types of Weakness	No. of Pupils	Per Cent
Poor Sense of Direction	1	2
Poor Sense of Pitch Relationship	11	26
Unstable in Pitch Maintenance	-	-
Combination of Types		
Poor Sense of Direction and Pitch Relationship	16	38
Poor Sense of Direction and Unstable in Pitch Maintenance	4	10
Poor Sense of Pitch Relationship and Unstable in Pitch Maintenance	3	7
Poor Sense of Direction, Pitch Relationship, and Pitch Maintenance	7	17
Number of Pupils	42	100

This would seem to be substantially in agreement with the generalization made by Drexler³ to the effect that she regards the ability to sing ascending intervals as a sign of maturity in the function of singing. Vance and Grandprey⁴ likewise found ascending intervals to be more difficult for pre-school children than were descending intervals.

3. Primary-grade pupils who have a well developed sense of tonality apprehension may make occasional pitch errors of all types in the singing of intervals and repeated tones and will still be able to maintain tonality. Table IX shows that thirty-five pupils in this category maintained tonality in spite of making an average of two pitch errors per performance.

4. Primary-grade pupils in this group who are capable of maintaining tonality grow in precision of singing from the first through the third grade. This is indicated by the data shown in Table IX, which shows the average number of errors per performance.

Inasmuch as the third grade pupils are the older pupils, this would agree with the generalization made by Mursell⁵, that there is a gradual advance in precision and accuracy concomitant with chronological development.

³Ethel N. Drexler, "A Study of the Development of the Ability to Carry a Melody at the Pre-School Level," Child Development, 9 (September, 1931), 319-332.

⁴F. T. Vance and M. B. Grandprey, "Objective Methods of Ranking Nursery School Children on Certain Aspects of Musical Ability," Journal of Educational Psychology, 22 (November, 1931), 577-585.

⁵James L. Mursell, The Psychology of Music, 345. New York: The W. W. Norton Company, Inc., 1937.

5. The data presented in Tables IX, XII, and XIII indicate that pupils of the primary-grades who have a well-developed sense of tonality will make fewer errors of all types per performance than will the pupils with less ability in this respect.

6. Primary-grade pupils who fail to establish tonality in the singing of familiar songs show tonal weaknesses with respect to melodic direction, pitch relationship, and pitch maintenance. Table XIV shows that the one most prevalent type of weakness found with the pupils studied was that of pitch relationship. The one combination of weaknesses most prevalent was that of melodic direction and pitch relationship.

7. The data on the average number of errors per performance shown in Tables IX, XII, and XIII seem to imply that if a child learns to establish tonality while in the first grade, he may make many errors of various kinds but is nevertheless likely to improve in his performance as he matures; whereas, if a child does not learn to establish tonality at the start in the first grade, he is likely to remain consistently poor throughout the primary grades.

Other Types of Errors

Errors other than those of intonation and pitch consisted of repeating melodic motives out of correct order, inventing new melodic material, and omitting tones.

Method of scoring errors caused by the repetition of melodic motives out of correct order, or by the invention of new melodic material.--
Errors of these two types were evaluated either as tonally defective

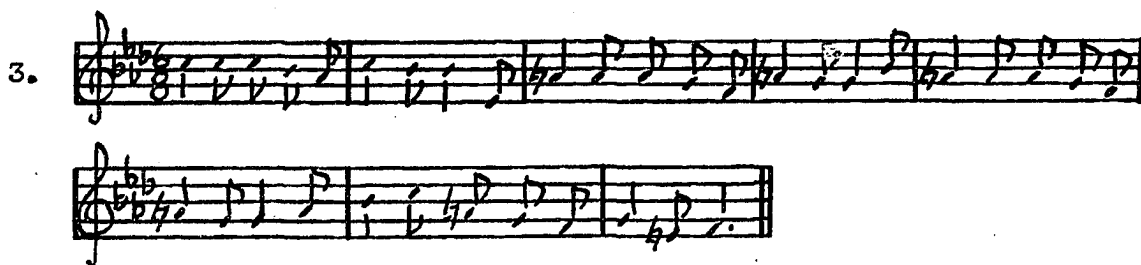
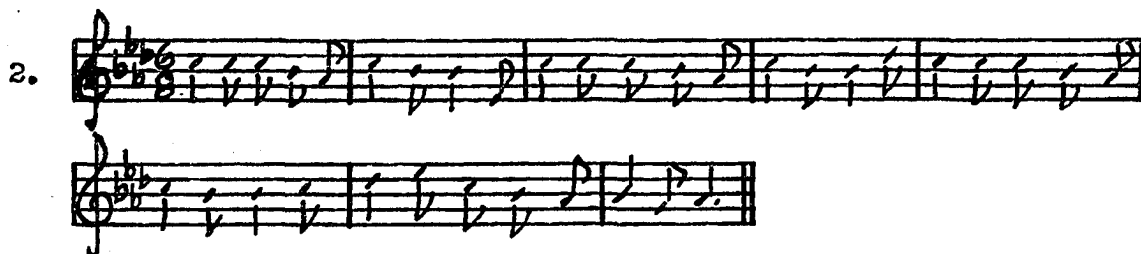
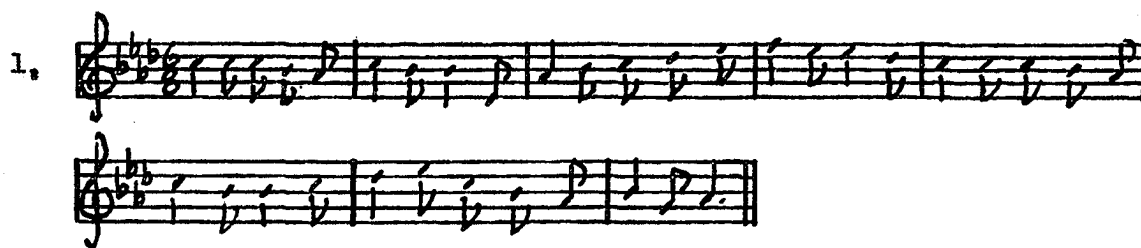
or as tonally non-defective. They were scored as tonally defective when they were produced out of the established tonality of the song. They were scored as tonally non-defective when they were made within the tonality of the song.

Figure 13 illustrates both types of melodic repetition. The song in this figure is "The Kangaroo". In the example of a tonally non-defective error, there is a repetition in measures three and four of the first motive, consisting of measures one and two. In this case the repetition is not out of the established key. For this reason, the error would not be considered as an indication of weakness in tonality apprehension. In the illustration of a tonally defective error, the motive has been transposed to a different tonality. It is, therefore, an indication of tonality weakness.

Figure 14 shows illustrations of tonally non-defective and tonally defective types of melodic inventions in singing the same song. In the illustration of the tonally non-defective type of melodic invention the singer has replaced the correct melody in measures three and four with a new melodic pattern. The new material, however, shows a retention of the key, and for this reason the response does not indicate tonality weakness. In the illustration of the tonally defective type of melodic invention, the child has replaced the melody of the same two measures with a different melodic pattern in a key foreign to the original tonality, a response which indicates tonality weakness.

Method of scoring errors caused by the omission of tones.--

These errors were likewise scored in two ways, as tonally defective and tonally non-defective. Errors were scored as tonally defective when the pupil failed to resume the tonality which he had used prior to the omission.



Key: 1. Correct melody.

2. Tonally non-defective type of melodic motive repetition.

3. Tonally defective type of melodic motive repetition.

Figure 13.--Types of Melodic Motive Repetition: Tonally Non-Defective, and Tonally Defective.

1. 

2. 

3. 

Key: 1. Correct Melody.

2. Tonally non-defective type of melodic invention.

3. Tonally defective type of melodic invention.


Figure 14.--Types of Melodic Invention: Tonally Non-Defective, and Tonally Defective.

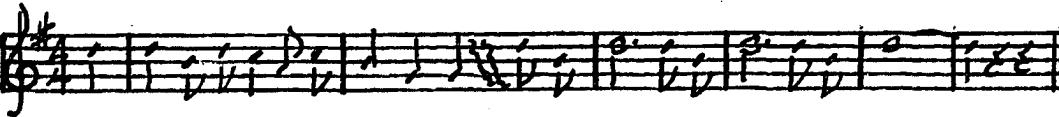
Figure 15 illustrates tonally non-defective and tonally defective errors of omission in "The Grasshopper". In the illustration of the tonally non-defective response, measures three and four of the melody have been omitted. Tonality for the final measures is resumed, a fact which indicates that the omission is not a sign of weakness of tonality apprehension. In the illustration of the tonally defective response, the same measures are omitted but the melody is resumed in a different key. A weakness of tonality is indicated.

Distribution of errors caused by the repetition of melodic motives, invention of new material, and the omission of tones.--Table XV shows the distribution of errors of these three types for all the subjects. The table also includes distributions for the three ability groups earlier distinguished. It may be noted: (1) that none of the pupils in Group I made tonally defective errors of these types; (2) that only four of the fifteen errors made by the pupils in Group II were tonally defective; and (3) that nine of the sixteen errors made by the pupils in Group III were tonally defective. This would seem to indicate that the stronger the sense of tonality the less likely a child is to make errors of these types.

Summary of the data on the repetition of melodic motives, the invention of new melodic material, and the omission of tones.--A study of the raw data from which Table XV is constructed leads to the following further generalizations.

1. Primary-grade pupils in this group who have a well developed sense of tonality apprehension, and who on occasion forget a portion of a song while singing it, will invent melodic material to supplant that which was forgotten, and will remain in the key tonality

1. 

2. 

3. 

Key: 1. Correct melody.

2. Tonally non-defective type of tone omissions.

3. Tonally defective type of tone omissions.

Figure 15.--Types of Tone Omissions: Tonally Non-Defective, and Tonally Defective.

TABLE XV
 DISTRIBUTION OF ERRORS MADE BY
 REPEATING MELODIC MOTIVES, INVENTING MELODIC
 MATERIAL, AND OMITTING TONES

Types of Errors	Group I	Group II	Group III	Total Errors
Repeating Melodic Motives				
Tonally non-defective	7	2	1	10
Tonally defective		1	1	2
Inventing Melodic Material				
Tonally non-defective	15	2		17
Tonally defective		2	1	3
Omitting Tones				
Tonally non-defective	9	7	6	22
Tonally defective		1	7	8
Total Errors	31	15	16	62

while doing so.

2. The invention of melodic material by pupils who are partially or poorly developed in tonality apprehension is characterized by a lack of melodic design and frequently has no identifiable tonality basis.

3. In songs, in which there are motives strongly similar but not exact in melodic progression, a few children have a tendency to repeat the first of two such motives in place of singing the correct melodic pattern when the second motive is indicated.

4. The omission of a few tones, especially when they occur at phrase endings, has little or no effect on a pupil's retention of tonality.

Relationship of Melodic Content to Tonality Apprehension

Ways of studying the relationship of melodic content to tonality apprehension.---The performance charts of the one hundred thirty-five subjects were analyzed to determine the size and direction of the intervals most frequently missed by them, and the semi-tone range and mean pitch level used by them in singing the songs. By semi-tone range is meant the range from the lowest to the highest tones sung by a pupil as expressed in terms of semi-tones, the latter being half-steps on the diatonic scale, as from E to F, or B to C. Thus if the lowest tone sung by a child while singing "America" were D^1 and the highest were D^2 he would be using a range of twelve semi-tones. The term mean pitch level refers to the average pitch of the song computed in number of semi-tones above the lowest tone of the song. For example, the mean pitch level

of "America", as written, is six semi-tones above the lowest pitch, F#¹, and the mean pitch tone corresponding to this is C².

The songs were also analyzed as to their requirements in terms of interval content, semi-tone range, and pitch level. These data were then compared and studied for the purpose of answering several specific questions, as follows:

1. What intervals were the most frequently missed?
2. What were the semi-tone range and pitch level used by the pupils of each ability group on each song?
3. Which songs were found to be the most difficult for each grade?
4. Is there a relationship between the interval content of the songs and their difficulty?
5. Is there a relationship between semi-tone range and pitch level required by the songs and their actual difficulty?

Analysis of interval content and distribution of interval errors.--Table XVI shows the percentage of possible errors made by pupils of the first grade in singing the various intervals of all their songs. The original data from which this table is derived are given in Appendix D. The ability groups are those previously given as indicative of ability or inability to establish and maintain tonality. The following paragraph illustrates the way in which Table XVI should be interpreted.

On the ascending intervals of the minor second contained in the songs sung by first grade pupils, the pupils in Group I made twelve errors (cf. Appendix D). If these subjects had sung all of these intervals incorrectly they would have made forty-two errors: twenty-seven

TABLE XVI

PERCENTAGE OF POSSIBLE ERRORS MADE ON THE VARIOUS
INTERVALS OF THE SONGS SUNG BY THE PUPILS OF THE FIRST GRADE

Intervals	Group I	Group II	Group III	All Groups
Ascending				
Minor Second	29	56	92	59
Major Second	20	40	76	46
Minor Third		62	100	35
Major Third	17	38	92	46
Perfect Fourth	12	31	94	41
Perfect Fifth		25	100	20
Minor Seventh		62	50	30
Descending				
Minor Second	5	23	73	23
Major Second	9	21	68	29
Minor Third	13	59	97	52
Major Third	40		100	57
Perfect Fourth		38	50	20
Perfect Fifth	33	50	100	66
Unisons	2	7	35	12
Percentage of Total Possible Errors	10.7	26.8	71.7	31.6

from "The Kangaroo," ten from "Away In A Manger," and five from "The Baker." The twelve errors which they made constitute 29 per cent of the total possible errors. The pupils in Group II made eighteen out of thirty-two possible errors or 56 per cent of the possible errors for this group. There were twenty-four possible errors for this group in "The Kangaroo" and eight in "Away In A Manger." The pupils in Group III made thirty-seven out of forty possible errors, or 92 per cent of the possible errors. These possible errors were distributed as follows: "The Kangaroo" thirty-six, "Away In A Manger" two, and "The Baker" two. All of the pupils of this group made a total of sixty-seven errors out of a possible 114 errors on this interval, or 59 per cent.

Table XVI shows the relative difficulty of various intervals found in the songs sung by the pupils of the first grade. If more than one error is made out of four possible errors, it is probably reasonable to assume that the child is finding the interval too difficult for him. The following generalizations as to the difficulty of various intervals are made on the assumption that an interval sung incorrectly more than twenty-five per cent of the time is too hard for the children singing it.

1. The ascending minor second, the descending major third, and the descending perfect fifth contained in one of the songs of this grade proved too difficult for the pupils of the first group. The fourth most difficult interval was the ascending major second.

2. All but four intervals out of thirteen were too difficult for the pupils in Group II. The four most difficult were the ascending minor third, the ascending minor seventh, the descending minor third, and the descending perfect fifth.

3. All the intervals were too difficult for the pupils in

Group III. The four most difficult were the ascending minor third, the ascending perfect fifth, the descending major third, and the descending perfect fifth.

4. For the grade as a whole, all but five intervals were too difficult, the four most difficult being the ascending minor second, the descending minor and major thirds, and the descending perfect fifth.

Tables XVII and XVIII show the percentage of possible errors made on all songs sung by the second- and third-grade pupils respectively. The same criterion of difficulty is used in the interpretation of these tables as was used with Table XVI.

Table XVII shows that:

1. The pupils in Group I made more than 25 per cent possible errors on four of the fifteen intervals contained in the songs sung by the children of the second grade. These were the ascending major and minor sixths, the ascending perfect fifth, and the descending perfect fourth.

2. The pupils in Group II found eight out of the fifteen intervals too difficult. The five most difficult for them were the ascending major sixth, the ascending perfect fifth, the ascending minor seventh, the ascending perfect fourth, and the descending perfect fourth.

3. All the intervals were too difficult for the pupils in Group III. The most difficult for this group were the ascending major third, perfect fourth, minor sixth, major sixth and minor seventh.

4. Eight of the fifteen intervals were too difficult for the second grade as a group. The most difficult were the ascending major and minor sixths, the ascending perfect fifth, the ascending minor seventh, and the descending perfect fifth.

TABLE XVII

PERCENTAGE OF POSSIBLE ERRORS MADE ON THE VARIOUS
INTERVALS OF THE SONGS SUNG BY THE PUPILS OF THE SECOND GRADE

Intervals	Group I	Group II	Group III	All Groups
<i>Ascending</i>				
Minor Second	3	7	78	14
Major Second	4	17	78	17
Minor Third	9	16	70	23
Major Third	25	38	100	33
Perfect Fourth	23	56	100	36
Perfect Fifth	49	68	50	40
Minor Sixth	38	33	100	41
Major Sixth	55	80	100	74
Minor Seventh	11	67	100	38
<i>Descending</i>				
Minor Second	7	18	67	17
Major Second	7	15	51	13
Minor Third	1	13	67	15
Major Third	15	44		24
Perfect Fourth	27	56	50	37
Minor Sixth	21	44	84	45
Unisons	4	3	21	5
Percentage of Total Possible Errors	9.4	17.9	63.9	18.6

TABLE XVIII

PERCENTAGE OF POSSIBLE ERRORS MADE ON THE VARIOUS
INTERVALS OF THE SONGS SUNG BY THE PUPILS OF THE THIRD GRADE

Intervals	Group I	Group II	Group III	All Groups
Ascending				
Major Second	7	24	60	27
Minor Third	1	29	79	32
Major Third	5	22	66	27
Perfect Fourth	11	54	96	49
Perfect Fifth	29	54	75	49
Descending				
Minor Second		43	87	39
Major Second	2	25	70	27
Minor Third		27	69	26
Major Third	19	28	92	39
Perfect Fourth	7	35	94	37
Perfect Fifth	5	26	83	33
Minor Sixth	29	57	95	55
Unisons	1	10	53	16
Percentage of Total Possible Errors	4.8	25.4	70.3	28.7

The data shown in Table XVIII disclose:

1. Pupils in Group I of the third grade found two out of the thirteen intervals contained in the songs sung by them to be too difficult. The four most difficult intervals for these children were the ascending perfect fourth and perfect fifth, and the descending major third and minor sixth.

2. Nine out of thirteen intervals were too difficult for the pupils in Group II. The ascending perfect fourth and perfect fifth, and the descending minor second and minor sixth were the four most difficult intervals for this group.

3. All of the intervals of these songs were too difficult for the pupils in Group III. Their most difficult intervals were the ascending perfect fourth and the descending major third, the descending perfect fourth, and the descending minor sixth.

4. For the grade as a whole only the unisons showed a percentage of possible errors of less than 25. The four most difficult intervals were the ascending perfect fourth and perfect fifth, and the descending major third and minor sixth.

Table XIX shows the percentage of possible errors made on the intervals of all songs sung by all subjects classified according to the three ability groups.

It reveals that:

1. For the pupils in Group I two intervals were too difficult, the ascending major and minor sixths.

2. For the pupils in Group II all but three out of the seventeen intervals were too difficult.

TABLE XIX

PERCENTAGE OF POSSIBLE ERRORS MADE ON THE INTERVALS
OF ALL SONGS SUNG BY ALL PUPILS CLASSIFIED BY GROUPS

Intervals	Group I	Group II	Group III	Total
Ascending				
Minor Second	12	21	87	30
Major Second	11	26	75	31
Minor Third	6	26	75	27
Major Third	1	28	77	33
Perfect Fourth	13	52	95	46
Perfect Fifth	19	55	75	39
Minor Sixth	38	33	100	41
Major Sixth	55	80	100	74
Minor Seventh	5	64	67	33
Descending				
Minor Second	5	26	77	24
Major Second	1	20	65	24
Minor Third	10	31	85	30
Major Third	19	33	86	35
Perfect Fourth	13	40	85	34
Perfect Fifth	10	29	88	39
Minor Sixth	21	49	87	48
Unisons	2	7	43	13
Total	8	23	69	26

3. The pupils in Group III found all intervals too difficult.

4. The three groups as a whole found the ascending major and minor sixths, the ascending perfect fourth, and the descending minor sixth intervals the most difficult.

From the data contained in Tables XVI, XVII, XVIII and XIX it is apparent that:

1. The wider ascending and descending intervals offer the greatest difficulty for the pupils of these grades.

This was also found to be true by Jersild and Bienstock⁵ who reported that seconds and thirds were reproduced more readily than the wider intervals by seventy children between thirty-one months and eight and one-half years of age.

2. Only the pupils in Group I have the tonal ability to meet the requirements of all of the intervals contained in these songs. Even these abler pupils need training with respect to the ascending major and minor sixths.

3. The vocal demands made by the intervals of these songs are beyond the ability of the pupils in Group II, and much beyond the ability of the pupils in Group III. This would seem to question the advisability of using these songs, or ones similar in difficulty, as material for these pupils.

⁵A. T. Jersild and S. F. Bienstock, "The Influence of Training on the Vocal Ability of Three-Year-Old Children," Child Development, 2 (October, 1931), 272-292.

Difficulty of songs expressed in terms of the per cent of possible errors scored on the intervals of each song.--In judging the difficulty of the songs, the criterion stated in the previous section relative to the difficulty of intervals was followed. By this criterion, if the number of errors made on the intervals of a song exceeds 25 per cent of the total possible errors for the song, the song is considered as probably too difficult.

Table XX shows the percentage of possible errors recorded for each group in the singing of the intervals of each song. These data are derived from the tables contained in Appendix C. The data shown in Table XX indicate:

1. None of the songs sung by pupils of Group I was too difficult for them. The four most difficult songs for these pupils were: "The Kangaroo," "The Baker," "Dinky Donkey," and "Fairy Fiddles."

2. Pupils of Group II found four songs too difficult: "The Kangaroo," "Dinky Donkey," "The Grasshopper," and "The Echo." All contain a preponderance of intervals wider than major and minor seconds.

3. All of the songs were too difficult for the pupils of Group III. The four most difficult were: "The Kangaroo," "The Baker," "Dinky Donkey," and "The Echo."

4. The most difficult song sung by the pupils of the first grade was "The Kangaroo." "The Baker" was more difficult than "Away In A Manger" for the small number of pupils who sang it, but the data are not sufficient to warrant a definite conclusion concerning this song.

TABLE XX
 PERCENTAGE OF POSSIBLE ERRORS MADE ON THE INTERVALS
 OF EACH SONG BY THE PUPILS OF EACH GROUP BY GRADES

Songs	Group I	Group II	Group III	Total
Grade One				
The Kangaroo	23	38	73	48
Away In A Manger	2	18	61	14
The Baker	10		76	30
Grade Two				
Dinky Donkey	14	27	72	34
The Grasshopper	5	30	39	19
America	2	11		13
Away In A Manger	4	17	35	11
Grade Three				
The Organ Man		22	62	22
Fairy Fiddles	9	16	64	25
The Echo	5	32	80	37

5. All of the songs sung by the pupils of the first grade were considerably beyond the ability of the pupils of the third group. "The Kangaroo" was too difficult also for the pupils in Group II.

6. Of the four songs sung by the pupils of the second grade, "Dinky Donkey" was the most difficult, with "The Grasshopper," second, "America," third, and "Away In A Manger," fourth. The latter two are predominantly diatonic.

7. "The Echo" was the most difficult song for the third-grade pupils. Only ten of the thirty-two tones in the song progress diatonically.

8. The easiest song for both the first and second grades was "Away In A Manger," which consists predominantly of descending diatonic melodic progressions. The other songs for these two grades, with the exception of "America," are not predominantly diatonic.

9. The easiest song for the third grade was, "The Organ Man," which contains in it twenty-two tones, only six intervals larger than a major second. Twelve of the twenty-two tones encompass a progression of a descending diatonic major scale.

The foregoing statements would seem to indicate that the easiest songs for the pupils of these grades are songs that are predominantly diatonic in nature. The songs which contain a preponderance of skips up and down and to both high and low tones were consistently found to be the most difficult for all pupils. This was likewise found to be true by Williams, Sievers and Hattwick,⁶ in a

⁶H. M. Williams, C. H. Sievers, and M. S. Hattwick, "The Measurement of Musical Development," Studies in Child Welfare, 7, No. 1, p. 88. Iowa City, Iowa: State University of Iowa, 1933.

study in which younger children were used as the subjects.

Range and mean pitch of songs used, as written and as sung.--

The tonal range and mean pitch of the songs used, as written and as sung by the subjects, are shown in Tables XXI, XXII, and XXIII for Groups I, II, and III, respectively.

These tables reveal a tendency for the pupils in Group I to approximate closely in their singing the actual range of tones in the songs as written, and to strike approximately the same average pitch as that indicated by the composer. Groups II and III deviate from the songs as written, by a narrowing of the range and a lowering of the pitch. They also reveal a tendency of the children in Group III to use a range extending from D^1 to C^2 or D^2 , and to use a preponderance of tones in their lower register. This seems to be in agreement with the findings of Williams, Sievers, and Hattwick,⁷ who likewise found that children of poor tonal ability almost invariably sing at the bottom of their pitch range. The children in the other two groups are more variable in this respect.

Effect of Lowering the Pitch of Songs on Singing Ability

Special cases.--While the pupils' responses were being recorded and transcribed, several cases were noted which were felt to be of particular interest. The cases so noted involved thirty pupils who experienced some difficulty with vocal production. The following

⁷H. M. Williams, C. H. Sievers, and M. S. Hattwick, op. cit., p. 88.

TABLE XXI

TONAL RANGE AND MEAN PITCH OF SONGS USED,
AS WRITTEN AND AS SUNG BY CHILDREN IN GROUP I

Song and Grade	N	Tonal Range				Mean Pitch Tone	
		Lowest and Highest tones		Number of Semi-tones		As Written	As Sung
		As Written	Mean Range as Sung	As Written	Mean Range as Sung		
Grade One							
The Kangaroo	9	E ^{b1} -F ²	E ¹ -E ²	14	12	B ¹	B ¹
The Baker	5	E ^{b1} -E ^{b2}	E ^{b1} -E ^{b2}	12	12	A ^{b1}	A ^{b1}
Away In A Manger	10	D ¹ -D ²	D ¹ -D ²	12	12	G ^{#1}	G ^{#1}
Grade Two							
Dinky Donkey	18	E ^{b1} -E ^{b2}	E ¹ -E ^{b2}	12	11	B ^{b1}	B ^{b1}
The Grasshopper	13	D ¹ -D ²	E ¹ -D ^{#2}	12	11	B ¹	B ¹
America	7	F ^{#1} -E ²	F ^{#1} -E ²	10	10	C ²	B ¹
Away In A Manger	9	D ¹ -D ²	D ¹ -D ²	12	12	G ^{#1}	G ^{#1}
Grade Three							
The Organ Man	16	F ¹ -F ²	F ¹ -F ²	12	12	B ^{b1}	B ^{b1}
Fairy Fiddles	12	E ^{b1} -E ^{b2}	E ^{b1} -E ^{b2}	12	12	G ¹	G ¹
The Echo	12	G ¹ -F ²	G ¹ -F ²	10	10	B ^{b1}	B ^{b1}

TABLE XXII

TONAL RANGE AND MEAN PITCH OF SONGS USED,
AS WRITTEN AND AS SUNG BY CHILDREN IN GROUP II

Song and Grade	N	Tonal Range				Mean Pitch Tone	
		Lowest and Highest Tones		Number of Semi-tones		As Written	As Sung
		As Written	Mean Range as Sung	As Written	Mean Range as Sung		
Grade One							
The Kangaroo	8	B ^{b1} -F ²	B ¹ -E ^{b2}	14	11	B ¹	B ^{b1}
Away In A Manger	8	D ¹ -D ²	D ¹ -D ^{#2}	12	13	G ^{#1}	G ^{#2}
Grade Two							
Dinky Donkey	10	E ^{b1} -E ^{b2}	E ¹ -E ^{b2}	12	11	B ^{b1}	B ^{b1}
The Grasshopper	3	D ¹ -D ²	F ¹ -F ²	12	11	B ¹	C ²
America	10	F ^{#1} -E ²	F ¹ -D ²	10	9	C ²	A ^{#1}
Away In A Manger	6	D ¹ -D ²	C ¹ -C ²	12	12	G ^{#1}	F ^{#1}
Grade Three							
The Organ Man	21	F ¹ -F ²	E ¹ -E ^{b2}	12	11	B ^{b1}	A ¹
Fairy Fiddles	13	E ^{b1} -E ^{b2}	D ¹ -D ²	12	12	G ¹	G ^{b1}
The Echo	15	G ¹ -F ²	F ¹ -E ²	10	11	B ^{b1}	A ¹

TABLE XXIII

TONAL RANGE AND MEAN PITCH OF SONGS USED,
AS WRITTEN AND AS SUNG BY CHILDREN IN GROUP III

Song and Grade	N	Tonal Range				Mean Pitch Tone	
		Lowest and Highest Tones		Number of Semi-tones		As Written	As Sung
		As Written	Mean Range as Sung	As Written	Mean Range as Sung		
Grade One							
The Kangaroo	12	E ^{b1} -F ²	D ¹ -D ^{b2}	14	11	E ¹	A ¹
The Baker	2	E ^{b1} -E ^{b2}	D ¹ -E ^{b2}	12	5	A ^{b1}	E ¹
Away In A Manger	2	D ¹ -D ²	D ¹ -C ²	12	10	G ^{#1}	G ¹
Grade Two							
Dinky Donkey	11	E ^{b1} -E ^{b2}	D ¹ -D ²	12	12	B ^{b1}	G ¹
The Grasshopper	1	D ¹ -D ²	D ¹ -D ²	12	12	E ¹	G ¹
Away In A Manger	1	D ¹ -D ²	D ^{#1} -E ²	12	13	G ^{#1}	A ¹
Grade Three							
The Organ Man	9	F ¹ -F ²	B-B ¹	12	12	B ^{b1}	F ¹
Fairy Fiddles	10	E ^{b1} -E ^{b2}	D ¹ -C ²	12	10	G ¹	G ^{b1}
The Echo	10	G ¹ -F ²	D ¹ -D ^{b2}	10	11	B ^{b1}	G ¹

paragraphs discuss the effects of lowering the pitch of the songs which they sang.

The effect of lowering the pitch of songs for pupils who experienced difficulty with vocal production. -- Seven pupils in the first grade experienced difficulty in producing tones above the pitch level of C². Six of this number who sang "The Kangaroo" in the published key of A^b, for their initial recording, included three pupils classified in Group II and three pupils in Group III. The seventh pupil sang "Away In A Manger" for her initial recording and was classified in Group III. Each of these pupils was given an opportunity to make a second recording at a later date. At this time the pitch for each of the songs was lowered. The pitch for "The Kangaroo" was lowered three semi-tones; the pitch for "Away In A Manger," two semi-tones. For four of the six pupils who sang "The Kangaroo," the second recording showed some improvement. One pupil in Group II equalled Group I standards. The other two pupils in Group II showed improvement but still failed to maintain tonality. One pupil in Group III equalled Group II standards on her second recording. No improvement was noted for the other two pupils in Group III. The pupil who sang "Away In A Manger" for her initial recording showed no improvement on her second trial.

Ten pupils in the second grade had difficulty in producing tones above D². All of this number sang "Dinky Donkey," and for their first recording sang it in the key of A^b, the key in which the song was published.

On their first recording, four were placed in the first group, three in the second, and three in the third. On the second

recording, for which they sang the same song in the key of F, all of the pupils experienced greater ease in producing the highest tones. One pupil of the first group corrected faulty intonation on his second recording. One pupil, who was in the second group on her first recording, equalled the performance of children in the first group on the second attempt. Some improvement was also noted for the other two. Two pupils in the third group showed little improvement on their second recording. The third pupil in Group III showed a slight improvement in his second recording.

Thirteen third grade pupils had difficulty in producing tones above D^2 . On their first recording of "Organ Man," in the key of F, the published key, two were placed in the first group, seven in the second group, and four in the third group. On their second recording, in the key of D, the two pupils in Group I sang with greater ease. Four of the pupils in the second group equalled the performance of pupils in the first, two showed improvement with greater ease in singing, and one failed to maintain the standard of the second group; three of the pupils in Group III showed no improvement, while the fourth pupil in this group showed enough improvement to equal the children in Group II.

A summarization of these data shows that:

1. All pupils in Group I sang with greater ease when the songs were pitched in a lower key. One pupil corrected faulty intonation on his second recording.
2. All but one pupil in Group II showed improvement on their second recording. Six out of thirteen improved enough to equal the performance of the pupils in Group I. One performed worse.
3. Two pupils in Group III performed as well as pupils in Group II; nine pupils in this group showed little or no improvement.

Although these data are not sufficient to form the basis for definite conclusions they do seem to indicate that, for pupils in Group I and Group II who experienced difficulty in producing tones above D^2 , lowering the pitch of the songs brought about greater ease and accuracy in singing.

This is partially in agreement with the generalization made by Jersild and Bienstock⁸ that the maintenance of tonality in the singing of melodies would be easier in songs incorporating only those tones written in the vocal range of young children than would be the case in songs using higher pitch levels and wider ranges. For the pupils in Group III, the data indicate that the lowering of the pitch of the songs has little effect on their singing ability.

Summary

This chapter has presented the data on the tonality apprehension of the 135 primary-grade children used as the subjects of the investigation.

The pupils were first classified into three groups on the basis of their ability or inability to establish and maintain tonality. A larger percentage of pupils in Group I, composed of the most capable singers, were found in the second grade than in the first or third grades. However, there were fewer pupils in the third grade in Group III than in either the first or second grades. This seemed to indicate some refinement

⁸A. T. Jersild and S. F. Bienstock, "The Influence of Training on the Vocal Ability of Three-Year-Old Children." Child Development, 2 (October, 1931), 272-292.

in ability as the pupils progress from the first to the third grades.

The data on the relationship between chronological age, grade placement, and tonality apprehension for all of the subjects showed the existence of a slight but insignificant relationship. They revealed considerable overlapping in ability from one age or grade to another in the primary grades.

A study of the types of tonal errors which these pupils made revealed that pitch errors have a greater effect upon the ability to establish and maintain tonality than either intonation errors or errors made by repeating melodic motives out of correct order, by inventing new melodic material, or by omitting tones. The one type of pitch error which was found to cause the most difficulty was the ascending interval. The data on pitch errors made by the pupils who maintained tonality on all songs sung by them indicated, for this group, a definite progression in quality of performance from the first grade to the third. Similar data for those who either did not maintain or failed to establish tonality indicated little or no improvement in ability after the second grade.

Major findings with regard to the relationship of melodic content to tonality apprehension indicate that (1) songs which contain a preponderance of skips up and down to high and low tones offer the greatest difficulty, (2) the wider intervals are the most difficult, (3) pupils in Group I tend to approximate closely the published range and pitch level of songs in their singing, and (4) pupils in Group III tend to use a preponderance of low tones in their singing.

Finally, improvement in the singing ability of twenty out of thirty subjects who experienced difficulty with vocal production resulted when the pitch of the songs was lowered to fit their range.

CHAPTER V

ANALYSIS OF DATA ON TONAL MEMORY

Introduction

This chapter presents the data on tonal memory, obtained by two procedures. The evidence obtained by the first procedure, in which primary-grade pupils were asked to recall the specific melodies of songs with which they were familiar, is discussed in the first section of the chapter. This procedure involved the singing, by memory, of songs previously learned in their music classes.

The evidence from the second procedure, in which a test was made of the ability of the subjects to reproduce dictated melodic materials after one hearing, is discussed in the second section of the chapter. This procedure involved the singing, by immediate recall, of several tone series and a musical phrase which had been sung to the subject. The melodic materials consisted of five four-tone, five five-tone, and five six-tone melodic groups, and a four measure, thirteen-tone phrase. The subject was required to respond by singing back to the investigator the tones which he had just heard. This procedure is comparable to that used in testing memory for words arranged in sentences.

Other interpretations of tonal memory are possible, e. g., power to recall after a long period of time, ability to re-learn a tonal series previously learned, and ability to recognize a tune as previously heard. The two aspects of tonal memory studied by this investigation were chosen because the data would supply better answers to several questions asked by the investigation relative to tonal memory in young children than would the study of other aspects

of tonal memory. The specific questions asked are given in subsequent paragraphs.

Final paragraphs summarize the material presented in the chapter.

Types of data.--The data obtained by the first procedure were studied to determine: (1) the types of tonal memory found in the singing of familiar songs presented in these grades; (2) the distribution of ability in each type; and (3) the relationship of tonal memory as expressed in this manner to chronological age, grade placement, and tonality apprehension.

The data obtained by the second procedure are arranged to show: (1) how each pupil ranked in the ability to repeat dictated melodic materials; (2) the classification of each pupil in relation to this ability; and (3) the types and distribution of errors made on the tone groups and the phrase. The data are further analyzed to determine the relationship of (1) the ability to reproduce tone-groups to the ability to reproduce the phrase; (2) chronological age, grade placement, and tonality apprehension to tonal memory as tested by these materials.

Tonal Memory Expressed in Terms of the Ability to Remember Specific Melodic Sequences

Purpose.--This phase of the study of tonal memory was undertaken for the purpose of answering five specific questions:

1. What types of tonal memory are evident in the memorization of song material?
2. How is each type distributed in the primary grades?
3. Is there a relationship between tonal memory and chronological age?

4. Is there evidence of a development in tonal memory from the first grade through the third grade?

5. Is there a relationship between tonal memory as measured by the ability to remember the specific melodic patterns of familiar songs and tonality apprehension as determined by the ability to remain in the same key while singing the same songs?

Pupils studied.--The pupils used as the subjects for this phase of the study consisted of the same group of 135 children whose ability with respect to tonality apprehension was discussed in the preceding chapter.

Song material employed.--The songs employed for the purpose of ascertaining the tonal memory achievement of the subjects were the same as those used to determine their tonality apprehension. As was described in Chapter IV, individual performance charts were constructed for each child's performance of each song.

Types of tonal memory.--The study of the performance charts revealed that these pupils could be grouped into three categories or classes in relation to tonal memory: (1) those who were able to sing precise melodic progressions; (2) those who were able to sing directionally; and (3) those who were unable to sing either with precision or with a sense of direction. For the purpose of this study, the pupils of the first group were considered as strong, with respect to tonal memory, those of the second group as fair, and those of the third group as weak.

Criteria of ability.--Certain criteria guided the investigator in classifying the subjects with respect to tonal memory. In order to be considered as strong, a pupil must have sung the entire song with a high degree of precision. Each tone must have been sung

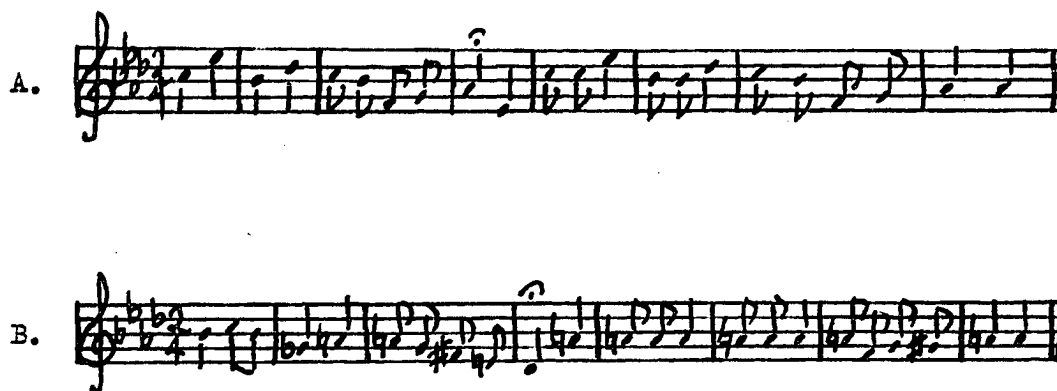
correctly with regard to its relationship to the other tones of the melody. Exceptions to this were allowed in cases such as obtained in the song "Dinky Donkey," where the endings of the first and the second phrases are so similar that a melodic error on either would be of little consequence as far as tonal memory is concerned.

To be classed as fair with respect to tonal memory a pupil must have sung the entire song with regard to its melodic contour. To limit the variability evident in the pupils of this group a further qualification was imposed: the contour of the melody as sung by the pupil must not have varied beyond three semi-tones either above or below the correct melody for more than half of any one complete phrase. An illustration of this type of tonal memory is shown in Figure 16.

Pupils of the weak group were those who evidenced little or no precision and whose sense of direction was so meager that they could not meet the conditions imposed for those with fair ability. An illustration of this type of pupil is shown in Figure 17.

Distribution of Ability

Classification of pupils.--All pupils were classified for ability on each song that they sang. A final classification was also assigned to each pupil which, for those pupils who performed only one song, was the same as the classification assigned to them for their performance on that one song. The final classification assigned to the pupils who sang more than one song was the classification which they were given on a particular song in each grade chosen because of its frequency of performance. The final classification thus given represents a qualitative rather than a quantitative classification. In this respect



Key: A. Correct melody.

B. Pupil response.

Figure 17.--Response Chart of Pupil Weak in Tonal Memory Ability

it is similar to the type of classification first used in Chapter IV.

In Chapter IV, classification of the subjects was made on the basis of their ability to sing the songs with a feeling of tonality. However, a pupil may sing a song with a well developed sense of tonality and still not sing the melody with precision or with a sense of direction.

The final classification for twenty-nine first-grade pupils was the same as the classification designated for their performance of "The Kangaroo." Eight pupils in this grade were classified on the basis of their performance of "Away In A Manger." Two pupils were classified on the basis of their performance of "The Baker."

The final classification for forty pupils of the second grade was based upon their performance of "Dinky Donkey." Eight pupils were given a final classification on the basis of their singing of "The Grasshopper." Two pupils were classified on the singing of "Away In A Manger" and "America," respectively.

The pupils of the third grade were classified on their performance of "The Organ Man."

Results of classification.--Tables XXIV and XXV show the number and per cent of pupils in each grade in each of three ability groups with respect to tonal memory expressed in terms of the ability to recall specific melodies of familiar songs.

These tables show that more than half of the pupils in Grade I are classified in Group III. The pupils in the second and third grades are more evenly distributed between Groups I, II and III.

TABLE XXIV
DISTRIBUTION OF SUBJECTS WITH RESPECT
TO TONAL MEMORY: FREQUENCIES

Ability Groups	First Grade	Second Grade	Third Grade	Total
Group I	8	17	16	41
Group II	11	16	14	41
Group III	20	17	16	53
Total	39	50	46	135

TABLE XXV
DISTRIBUTION OF SUBJECTS WITH RESPECT
TO TONAL MEMORY: PERCENTAGES

Ability Groups	First Grade	Second Grade	Third Grade	Per Cent
Group I	21	34	35	30
Group II	28	32	30	30
Group III	51	34	35	40
Per Cent	100	100	100	100

Relationship of Recall of Songs to Chronological
Age, Grade Placement, and Tonality Apprehension

Relationship of tonal memory to chronological age.--

Table XXVI presents the data for the computation of the coefficient of contingency for the relationship between recall of songs and chronological age. The size of the coefficient, .21, indicates a slight but significant relationship.

Relationship of tonal memory to grade placement. --Table

XXVII presents similar data on the relationship between recall of songs and grade placement. The coefficient of contingency, .24, is also small but significant. Some children apparently make little or no development musically as they progress through the first three grades.

Tables XXVI and XXVII indicate a great deal of overlapping in ability from age group to age group and from grade to grade.

Relationship of tonal memory to tonality apprehension.--

Table XXVIII shows the distribution of pupils in each of the three ability groups on tonal memory and tonality apprehension. The data were derived from the final classification assigned to each pupil on (1) tonal memory and (2) tonality apprehension. The final classification for both of these abilities was computed on each pupil's performance of the same song. That is, the final classification on tonal memory for pupil number one of the first grade was based upon the performance of the

TABLE XXVI

DATA FOR COMPUTATION OF COEFFICIENT OF CONTINGENCY
FOR CHRONOLOGICAL AGE AND RECALL OF SONGS

Age Groups	Ability Groups			Total
	Group I	Group II	Group III	
105-112	8	7	9	24
97-104	13	9	8	30
89-96	10	10	13	33
81-88	6	9	11	26
73-80	4	6	12	22
Total	41	41	53	135
			P	1.0472
			C	.21

TABLE XXVII

DATA FOR COMPUTATION OF COEFFICIENT OF CONTINGENCY
FOR GRADE LEVEL AND RECALL OF SONGS

Grades	Ability Groups			Total
	Group I	Group II	Group III	
First Grade	8	11	20	39
Second Grade	17	16	17	50
Third Grade	16	14	16	46
Total	41	41	53	135
			P	1.0609
			C	.24

TABLE XXVIII
 NUMBER OF PUPILS IN EACH OF THREE ABILITY
 GROUPS ON TONALITY APPREHENSION AND TONAL MEMORY

Tonality Apprehension	Tonal Memory			Total
	Group I	Group II	Group III	
Group I	41	8	4	53
Group II		32	13	45
Group III		1	36	37
Total	41	41	53	135
			P	2.101
			C	.72

same song as was his final classification on tonality apprehension. The obtained coefficient of contingency, .72, indicates that for these pupils there is a fairly high and significant positive relationship between the two abilities. From the data shown in Table XXVIII it appears that the children who are poor in tonality apprehension tend to be poor in tonal memory and that the children who are strong in tonality apprehension tend to have corresponding strength in tonal memory.

Tonal Memory Expressed in Terms of
the Ability to Reproduce Tone Groups and a
Musical Phrase after one Hearing

Purpose.---The data on tonal memory measured in terms of the ability of primary grade children to reproduce tone groups and a short musical phrase after one hearing were obtained for the purpose of ascertaining the answers to five questions. These are:

1. How is tonal memory, as tested by these materials, distributed with the singer-group of children in these grades?
2. What types of errors do they make under the conditions of the investigation? How are these errors distributed?
3. Is there a relationship between the ability to sing the tone groups and the ability to sing the phrase?
4. Are chronological age and grade placement related to tonal memory as tested by these materials?
5. Is there a relationship between tonality apprehension and tonal memory as tested in this manner?

Pupils studied.---The pupils used as the subjects for this phase of the investigation comprised the primary-grade choir of the school at which the study was conducted. As members of this organization, these pupils were considered as the "singer-group" of the first three

grades. Their selection for membership in this choir was made by the elementary school music teacher. It was based upon the ability of the children to sing with melodic accuracy a song which had been previously taught to all pupils of these grades. The accuracy of their singing was a matter of judgment on the part of the music teacher.

While this group numbered sixty-four pupils, only fifty-eight were available at the time the investigation was conducted. Of this number, fifteen were from the first grade, twenty-two were from the second grade, and twenty-one were from the third grade.

As stated on page 59, only the singer-group of pupils was used in this phase of the investigation. The use of only this group was felt to be justified on the basis of the nature of the testing materials and the fact that the test demanded a degree of singing ability not characteristic of the other children.

The data shown in the tables throughout the rest of this chapter are based upon the performance of this group of fifty-eight pupils.

Testing material employed.--The material used for the purpose of determining the tonal memory ability of these pupils consisted of three series of tone groups, and one four-measure musical phrase.

The three series of tone groups consisted of five four-tone groups, five five-tone groups, and five six-tone groups. The tone groups were selected from songs contained in the song texts used by the three grades. The beginning and ending melodic progressions and the phrase endings of the songs were enumerated, and the ones most frequently employed in the songs were arranged into the tone-groups used in this study. They were adapted from the song texts without regard to their

rhythmic construction as shown in the songs, and were dictated according to the rhythmic pattern shown in Figure 1 of Appendix B.

The musical phrase was an invention of the investigator based upon the frequent use of tonic triad tones and descending diatonic passages contained in the song literature of the grades studied. It is shown in Figure 2 of Appendix B.

Performance charts.--The data were recorded on performance charts derived from the recordings made by each pupil. The recorded responses were transcribed to music manuscript paper by comparing the recorded pitch of each tone with the tones of a piano tuned to the frequency of 440 vibrations per second for the pitch of A. The standard was the same as that of the instrument used in standardizing the pitch of the dictated testing material. To assure accuracy, each transcription was checked a minimum of three times.

Method of scoring the performance charts.--The responses of the pupils as transcribed on the performance charts were compared with the correct test items to determine the scores for each pupil. Errors were noted when a performance chart varied from the dictated test item.

Types of errors.--In scoring the charts three types of errors were noted: (1) incorrect tones sung; (2) tones omitted; and (3) tones added.

Method of scoring errors on the tone groups.--Errors of the first type were scored when a pupil's response chart showed the singing of a tone or tones foreign to the series of dictated tones comprising the tone groups.

For example, the tones of the first group of tones in the four-tone group were A^{b1}, C², E^{b2}, A^{b1}. If a pupil's response chart

showed the pupil singing a tone foreign to this series, such as A^{b1} , C^2 , B^{b1} , A^{b1} , an error of this type would be recorded against him.

An error of the second type would be scored against a pupil if his response chart showed that any one of the tones of a series had been omitted by him. For example, if his response to the series given above showed him singing A^{b1} , C^2 , A^{b1} , it was concluded that he had omitted the E^{b2} and an error of this type was scored against him.

An error of the third type was scored against a pupil when his response chart showed that he had added one or more tones to a dictated series. For example, if his response to the same series showed A^{b1} , B^{b1} , C^2 , E^{b2} , A^{b1} , one error was scored for the added B^{b1} .

Method of scoring errors made on the phrase.--In scoring the errors made in singing the phrase, the entire phrase was considered as a four-measure unit consisting of thirteen tones. The first two measures consisted of the tones F^1 , A^1 , C^2 , C^2 ; the third measure contained B^{b1} , A^1 , G^1 , and G^1 ; and the fourth measure, one tone, F^1 . Errors were scored for those pupils whose response chart indicated the production of tones not in agreement with the dictated materials, when their response indicated the omission of tones, or when they added tones. For example, the response chart of pupil number one of the first grade showed the following: for measure one, C^2 , B^{b1} , A^1 , G^1 ; for measure two, G^1 , B^{b1} , and C^2 for one count only; for measure three, C^2 , B^{b1} , A^1 and G^1 , and nothing for measure four. On the basis of the above plan, this pupil was scored with four errors for the first measure, three for the second, three for the third, and one for the fourth, or a total of nine incorrect tones and two omitted tones.

Classification of Pupils on Tonal Memory Ability

Ranking of Pupils.--Following the scoring of the response charts for the three series of tone groups and the phrase, each pupil was assigned a rank which took into account the number of errors which he had made. Those pupils who made the smallest number of errors were assigned the ranks of lowest numerical value. Table XXIX shows for each pupil the total number of errors made on the tone groups and the assigned rank. The assigned rank and the number of errors made on the phrase by each pupil are shown in Table XXX.

Classification of pupils into three ability classes.--The pupils of each grade were classified into three ability classes with respect to tonal memory ability as evidenced in their singing of the tone groups and the phrase. The ability classes were designated as being strong, fair and weak.

Method of classification.--The classification for each pupil was determined by computing the average number of errors and the standard deviation for all grades as a group on the tone groups and the phrase. All pupils in each grade who made fewer errors than the number indicated as being one standard deviation below the average for all grades were classified as strong. All pupils who scored between one standard deviation below the average and one standard deviation above were classified as fair. All pupils who made more errors than the number indicated as being one standard deviation above the average were classified as weak.

Classification of pupils on the tone groups and the phrase.--Table XXXI shows the number and per cent of pupils in each grade in each

TABLE XXIX

RANKING OF FIFTY-EIGHT PRIMARY GRADE PUPILS ON THE
ABILITY TO REPRODUCE TONE GROUPS AFTER ONE HEARING

Pupil	Errors	Rank	Pupil	Errors	Rank
* 16-3	1	1	8-1	19	30
14-1	2	2	13-3	19	30
11-3	3	3	1-3	20	32
21-2	4	4.5	7-3	21	33.5
3-3	4	4.5	10-3	21	33.5
15-1	5	6	13-1	22	36
6-3	6	7.5	22-2	22	36
18-3	6	7.5	14-3	22	36
13-2	7	9	12-3	23	38
10-2	8	10	11-1	24	39
2-3	9	11	7-1	25	40
5-2	10	12.5	5-3	26	41
8-2	10	12.5	15-3	27	42
9-1	11	14	2-2	28	43.5
4-3	12	15.5	7-2	28	43.5
6-2	12	15.5	9-3	29	45.5
12-1	13	18.5	20-3	29	45.5
9-2	13	18.5	5-1	30	48
20-2	13	18.5	6-1	30	48
21-3	13	18.5	3-2	30	48
4-2	15	22	1-2	33	50
12-2	15	22	18-2	34	51.5
17-3	15	22	19-2	34	51.5
10-1	17	24.5	2-1	35	53.5
8-3	17	24.5	19-3	35	53.5
4-1	18	27	1-1	41	55
16-2	18	27	11-2	42	56
17-2	18	27	14-2	49	57.5
3-1	19	30	15-2	49	57.5

* Pupil 16, Grade 111.

TABLE XXX

RANKING OF FIFTY-EIGHT PRIMARY GRADE PUPILS ON THE
ABILITY TO REPRODUCE A MUSICAL PHRASE AFTER ONE HEARING

Pupil	Errors	Rank	Pupil	Errors	Rank
8-3	0	1.5	15-3	5	29
16-3	0	1.5	4-3	6	31.5
4-1	1	4.5	20-3	6	31.5
21-2	1	4.5	17-2	7	33
6-3	1	4.5	2-1	8	34.5
18-3	1	4.5	19-3	8	34.5
10-1	2	8.5	3-1	9	38.5
20-2	2	8.5	5-1	9	38.5
3-3	2	8.5	8-1	9	38.5
10-3	2	8.5	13-1	9	38.5
8-2	3	14.5	12-2	9	38.5
9-1	3	14.5	11-3	9	38.5
13-2	3	14.5	11-1	10	43.5
19-2	3	14.5	6-1	10	43.5
5-3	3	14.5	6-2	10	43.5
13-3	3	14.5	14-2	10	43.5
14-3	3	14.5	1-1	11	49
21-3	3	14.5	1-2	11	49
12-1	4	23	4-2	11	49
14-1	4	23	11-2	11	49
15-1	4	23	18-2	11	49
10-2	4	23	22-2	11	49
5-2	4	23	17-3	11	49
7-2	4	23	7-1	12	53.5
15-2	4	23	2-2	12	53.5
2-3	4	23	9-2	13	56
12-3	4	23	1-3	13	56
16-2	5	29	7-3	13	56
9-3	5	29	3-2	18*	58

*Pupil 3-2 added 14 tones.

TABLE XXXI

CLASSIFICATION OF FIFTY-EIGHT PRIMARY GRADE
PUPILS INTO THREE CLASSES ON THE ABILITY
TO REPRODUCE TONE GROUPS AFTER ONE HEARING

Groups	Error Range	Grade I		Grade II		Grade III		Total	Per Cent
		W	Per Cent	W	Per Cent	W	Per Cent		
Strong	0-8	2	13	3	14	5	24	10	17
Fair	9-32	11	74	13	59	15	71	39	67
Weak	33-	2	13	6	27	1	5	9	16
Total		15	100	22	100	21	100	58	100

of three classes, classified on the ability to reproduce tone groups after one hearing. The mean number of errors for all children was 20, with a standard deviation of 12. Table XXXII shows similar data for the phrase. The mean number of errors for the phrase was 6 with a standard deviation of 4.

Distribution and Analysis of Errors

Types of errors.--As explained in a previous paragraph, errors made on the tone groups and the phrase were of three types: (1) incorrect tones were sung; (2) tones were omitted; and (3) tones were added.

Distribution and analysis of errors made on the tone groups.--Table XXXIII shows the number of errors of all types for each series of the tone groups. The mean for each series is likewise shown. The table shows that the errors most frequently made were of incorrect tones. Three out of four errors were of this type. Omission of tones accounted for one out of four errors. Errors caused by the addition of tones were so few as to be of no particular consequence.

Distribution and analysis of errors made on the phrase.--Table XXXIV shows the number of errors of all types made by the pupils in singing the phrase. It also shows the per cent of errors for each type and the mean and standard deviation. The table shows that two out of three errors were due to the singing of incorrect tones. The omission of tones accounted for 31 per cent of the errors, and added tones accounted for only 6 per cent.

The data on the distribution and analysis of errors lead

TABLE XXXII

CLASSIFICATION OF FIFTY-EIGHT PRIMARY GRADE
PUPILS INTO THREE CLASSES ON THE ABILITY TO
REPRODUCE A MUSICAL PHRASE AFTER ONE HEARING

Groups	Error Range	Grade I		Grade II		Grade III		Total	Per Cent
		N	Per Cent	N	Per Cent	N	Per Cent		
Strong	0-2	2	13	2	9	6	29	10	17
Fair	3-10	11	73	12	55	12	57	35	60
Weak	11-13	2	13	8	36	3	14	13	23
Total		15	99	22	100	21	100	58	100

TABLE XXXIII

DISTRIBUTION OF THREE TYPES OF ERRORS MADE
IN RECALL OF TONE GROUPS BY 58 PUPILS

Types of Errors	Four- Tone Series*	Five- Tone Series*	Six- Tone Series*	Total	Per Cent
Incorrect Tones	97	244	529	870	75
Tones Omitted	21	111	139	271	23
Tones Added	3	4	13	20	2
Total Errors	121	359	681	1161	100
Mean Per Series	.45	1.24	2.38		

* Five series of each length were included.

TABLE XXXIV
 DISTRIBUTION OF THREE TYPES OF ERRORS
 MADE IN RECALL OF THE PHRASE

Types of Errors	Total	Per Cent
Incorrect Tones	244	63
Tones Omitted	121	31
Tones Added	24	6
Total Errors	389	100
N	58	100
Mean	6.07	
S. D.	3.89	

to the following conclusions:

1. Primary-grade pupils of the "singer-group" vary widely in tonal memory as tested by a performance test.
2. On the basis of the mean number of errors for the various series of tone-groups, the children studied have considerable ability in the reproduction of four-tone units. Beyond this number of tones per unit their tonal memory becomes increasingly unreliable.
3. The singing of incorrect tones accounts for the largest percentage of tonal memory errors. Only two errors in ten on the tone groups, and three errors in ten on the phrase were due to the omission of tones.

Relationship Between the Ability to Reproduce
the Tone Groups and the Ability to Reproduce the Phrase

Method used to determine relationship. -- The rank-difference method was used to determine the relationship between the ability to reproduce the tone groups and the ability to reproduce the phrase. The formula, as given by Garrett¹, for computing the correlation by this

¹H. E. Garrett, Statistics in Psychology and Education, Chapter IV, p.190. New York: Longmans, Green and Company, 1933.

method, is $\rho = 1 - \frac{6D^2}{N(N-1)}$. The statistic ρ was transmuted into a product moment r by means of a table which indicates the value r for any given value of ρ^2 . The formula for finding the probable error of the coefficient ratio, is $PEr = \frac{.7063(1-r^2)^{.3}}{N}$.

Correlation found.--The correlation coefficients found by this procedure are ρ , + .55; $r\rho$, + .57. The probable error of $r\rho$ is .06. These results indicate a significant positive relationship between the two measures of tonal memory, ability to reproduce tone groups and ability to reproduce a phrase. The relationship is far from perfect, however.

The relationship between the two abilities with respect to tonal memory is possibly lower than it would be were the measures highly reliable. Both measures involve the singing of only a few tones.

Relationship of Recall of Tone Groups and a
Musical Phrase to Chronological Age, Grade
Placement, and Tonality Apprehension

Method used to determine relationships.--The relationship of tonal memory to the factors of age, grade placement, and tonality apprehension was determined by computing the coefficient of mean square contingency for each.

Relationship of tonal memory to chronological age.--Table XXXV shows a classification of the pupils in terms of age and ability to

²H. E. Garrett, op. cit., p. 190.

³Ibid., p. 191

TABLE XXXV

RELATIONSHIP BETWEEN CHRONOLOGICAL AGE AND
THE ABILITY TO REPRODUCE TONE-GROUPS

Age Groups	Ability Groups			Total
	Weak	Fair	Strong	
104-110	1	7	4	12
97-103		11	1	12
90-96	5	6	2	13
83-89	1	8	2	11
76-82	2	7	1	10
<u>Total</u>	9	39	10	58
			P	1.1497
			C	.36

reproduce tone groups after one hearing. The coefficient of contingency of .36 indicates for these pupils a small but significant relationship between age and this ability. Table XXXVI is constructed similarly with respect to the ability to sing the phrase. It shows a coefficient of contingency of .33, which again indicates a small but significant relationship.

Relationship of tonal memory to grade placement.-- Table XXXVII presents a classification of the pupils in terms of grade placement and ability to recall the tone groups. The coefficient of contingency, C , computed from the data in this table, is .23, indicating a small but significant relationship between grade placement and tonal memory, as measured by recall of tone groups. Table XXXVIII presents similar data for grade placement and ability to recall a phrase. The relationship found for the data in this table (C equals .36) is slightly greater than that for grade placement and ability to recall tone groups.

The data shown in Tables XXXV to XXXVIII reveal that tonal memory, as measured by the abilities to sing tone groups and a phrase after one hearing, has a small but significant relationship to general maturity and grade advancement at these age and grade levels. This relationship is not so large as one might expect considering the fact that only the superior singers were used in this phase of the study. This seems to indicate that the type of training which these pupils receive has not been designed to increase achievement in tonal memory. This was also found to be true with respect to tonality apprehension, as shown in Chapter IV.

Relationship of tonal memory to tonality apprehension.--

Table XXXIX shows the data on tonal memory as determined by the ability to reproduce tone groups and the data on the tonality apprehension of these pupils. The tonality apprehension groups were described as well

TABLE XXXVI
 RELATIONSHIP BETWEEN CHRONOLOGICAL AGE AND
 THE ABILITY TO REPRODUCE A MUSICAL PHRASE

Age Groups	Ability Groups			Total
	Weak	Fair	Strong	
104-110	2	7	3	12
97-103	3	6	3	12
90-96	5	7	1	13
83-89	2	8	1	11
76-82	1	7	2	10
Total	13	35	10	58
			P	1.12596
			C	.33

TABLE XXXVII
 RELATIONSHIP BETWEEN GRADE PLACEMENT AND
 THE ABILITY TO REPRODUCE TONE-GROUPS

Grades	Ability Groups			Total
	Weak	Fair	Strong	
One	2	11	2	15
Two	6	13	3	22
Three	1	15	5	21
Total	9	39	10	58
			P	1.0548
			C	.23

TABLE XXXVIII
 RELATIONSHIP BETWEEN GRADE PLACEMENT AND
 THE ABILITY TO REPRODUCE A MUSICAL PHRASE

Grades	Ability Groups			Total
	Weak	Fair	Strong	
One	2	11	2	15
Two	8	12	2	22
Three	3	12	6	21
Total	13	35	10	58
			P	1.1489
			C	.36

TABLE XXXIX

RELATIONSHIP BETWEEN TONALITY APPREHENSION
AND TONAL MEMORY AS TESTED BY THE ABILITY
OF FIFTY-EIGHT PRIMARY GRADE PUPILS TO
REPRODUCE TONE GROUPS

Ability Groups Tonality Apprehension	Tonal Memory-Tone			Total
	Weak	Fair	Strong	
Group I	6	26	9	41
Group II	3	13	1	17
Total	9	39	10	58
			P	1.0793
			C	.27

developed, partially-developed, and poorly-developed. The three groups of tonal memory ability were defined as strong, fair, and weak. For reasons previously given, no pupils from the poorly-developed class on tonality apprehension were selected for this phase of the study on tonal memory. The obtained C of .27 indicates the presence of a small significant degree of positive correlation between the two abilities.

Table XL, constructed similarly, shows the data on tonal memory as tested by the ability to reproduce the phrase and the data on tonality apprehension. The C of .28 indicates that the two abilities are positively related to a significant degree.

The similarity of the two coefficients is probably due to the presence of common elements in both tests.

It may be noted that the coefficient of contingency obtained for the relationship between tonal memory expressed in terms of the ability to recall the songs and tonality apprehension (C equals .72) was slightly higher.

Summary

This chapter has presented an analysis of the data on tonal memory. This trait was studied in two ways and with two groups of children. The first gave attention to the ability of the 135 pupils to remember the specific melodies of familiar songs. The second gave attention to the ability of 58 pupils of the "singer group" to repeat three series of dictated tone groups and a musical phrase after one hearing.

TABLE XL

RELATIONSHIP BETWEEN TONALITY APPREHENSION
AND TONAL MEMORY AS TESTED BY THE ABILITY OF
FIFTY-EIGHT PRIMARY GRADE PUPILS TO
REPRODUCE A MUSICAL PHRASE

Tonality Apprehension	Tonal Memory-Phrase			Total
	Weak	Fair	Strong	
Group I	11	21	9	41
Group II	2	14	1	17
Total	13	35	10	58
			P	1.0868
			C	.28

The data which considered the ability to remember specific melodies were analyzed to determine the types of ability present and their distribution. They showed that some pupils sing with precision, some with only a sense of direction, and some without either of these characteristics. The relationship between this aspect of tonal memory and tonality apprehension was found to be fairly high and positive. In effect, on the basis of this, one would expect these two attributes of musicality to be coexistent in a child to a considerable degree when either tonality apprehension or tonal memory is discovered to be in existence. It is also possible that good tonality apprehension is fundamental to the development of good tonal memory and vice-versa, and that inferior ability in either is a limiting factor in the development of the other. Little relationship was shown for this type of tonal memory and age or grade placement. Perhaps if songs were taught in such a way as to emphasize development in tonality apprehension some improvement would have been shown in tonal memory from grade to grade.

Pupils were classified arbitrarily at three levels of ability to repeat tone groups and a phrase after only one hearing. A small but significant relationship between the ability to repeat the tone groups and the ability to repeat the phrase was determined by the rank-differences method. It was probably not a reliable index of the true correlation between the two abilities as one would ordinarily expect a higher degree of correlation since both abilities have many elements in common. That the relationship was not so high as it possibly should be may be accounted for by the brevity of the tests.

The errors made on the tone groups and the phrase were analyzed. Findings indicated a wide variation in the ability of the pupils studied, a greater degree of tonal memory ability needed to reproduce a phrase than shorter tone units, and only fair reliability on tone groups of more than four tones. The singing of incorrect tones accounted for the largest percentage of errors on both types of material. A possible explanation of this may be that pupils of the primary grades, while not always able to remember melodic figures precisely, have the ability to sense such figures as complete units and to supply the correct number of tones to make them complete.

A small but significant relationship was shown to exist between tonal memory, as tested by the singing of tone groups and the phrase, and tonality apprehension. The extent of the relationship was probably affected by the unreliability of the tests for tonal memory.

Little relationship was shown to exist between chronological age and grade placement and tonal memory. This again points to an overlapping of ability in age and grade groups when specific training in tonal memory is not given.

CHAPTER VI

Summary and Conclusions

The problem.--This is an investigation in the psychology of musical development. It is concerned with the growth of two musical powers in a group of children enrolled in the primary grades of an American public school, with the individual differences which these children show in these musical traits, and with certain factors associated with these abilities. One of the major concerns of this investigation is with the significance of the two traits chosen for study, from the point of view of the musical education of young children. No attempt is made in this study to develop techniques of improving performance in either trait, although the study has implications for this problem.

Related literature and research.--This investigation grows out of and adds to the literature and research upon the nature and functioning of musicality in general, and upon two specific factors of musicality, namely, tonality apprehension, and tonal memory, in particular. Following a brief account of the general literature in this area, the conclusions of the present study will be presented. Where appropriate, reference will be made to the findings of earlier investigations and a comparison will be made with the results of this study.

Literature on musicality.--The literature on the nature of musicality discloses three views. One view holds that it is not a distinct trait marked off from other traits and existing in isolation. A second view holds musicality to be a distinct faculty measurable in terms of sensory acuity to musical stimuli. A third view differentiates between musicality and talent. The present investigation, in keeping with the

trend of opinion on this problem, assumes musicality to be a composite of several interdependent elements or traits dependent upon sensory acuity for proper functioning but not entirely determinable by testing only isolated sensory capacities.

The psychologists who have attempted to analyze musicality have proposed various lists of diagnostic signs. Mursell suggests thirteen, Seashore lists five, and Schoen offers three as primary and five as secondary. All authorities attach importance to the two areas investigated by this study.

Other topics treated in this literature include the relationship between musicality and age, the relationship between musicality and intelligence, and the inheritance of musicality. Only the first of these problems was investigated in this study. The present study offers data on the level of attainment reached in the two traits studied, by children of grades one to three, aged six years to nine years four months.

Research on tonality apprehension and tonal memory.--A

review of the research literature on tonality apprehension reveals considerable work on the elements of tonality feeling but little on tonality feeling as such. In this investigation attention is directed specifically to the problem of tonality apprehension and the classification of the subjects is wholly in terms of their ability to establish and maintain a key tonality in their singing of songs. The study made in this investigation of certain elements of tonality, such as pitch and intonation, was for the purpose of determining their relationship to tonal ability, whereas the elements of tonality investigated in the studies reviewed were considered only as isolated tonal problems. Most

of the studies on tonality apprehension have used pre-school children as subjects. As was pointed out earlier, this study supplies evidence on primary-grade children.

The studies on tonality apprehension indicate an increase in general musical ability with an increase in age. This conclusion holds for the ability to reproduce single tones, motifs, and phrases, the ability to sing intervals, the ability to sing songs, the ability to sing a second song in the same key as a first song, and the ability to recognize key alteration.

Studies of the ability to sing intervals report that ascending intervals are found to be more difficult than descending intervals, thirds are easier to sing than seconds, and semi-tone intervals are used by children in their free melodizing. The ability to sing intervals has been found to be amenable to training.

Several studies report that children use lower tones in the singing of songs than are commonly included in the published versions of songs for children.

Studies on tonal memory are comparatively few in number and differ in purpose, technique, and subjects from the present investigation. Those reviewed are concerned with several aspects of tonal memory. It was found to be an attribute of musical people and to be lacking in unmusical people. When tested in a performance situation, tonal memory has high prognostic value in determining musical ability. The Seashore test of tonal memory has been reported to be an index of minimum ability in singing. The present study deals with the tonal memory ability of primary-grade children in the performance of familiar songs and in the immediate recall of dictated tonal materials.

Procedure.--The research methodology of the present study may be described as either normative-survey or genetic. The data provide a survey of certain musical abilities of a group of primary-grade children. However, the data are interpreted in terms of child development during the years of primary schooling. The stages to which these children had developed with respect to tonality apprehension and tonal memory were observed and comparisons were drawn between groups of differing ability.

One hundred thirty-five primary-grade children were asked to record individually several familiar songs. Fifty-eight of these children were also asked to record individually their performance on three series of tone groups and a musical phrase. All of the children were from the Edwin D. Smith elementary school of Oakwood, Dayton, Ohio.

The equipment used to obtain the recordings was an instantaneous type recorder. A metronome was also used in the dictation of the tone groups and the phrase, to keep the time and tempo span constant from child to child.

The testing materials consisted of songs which were selected from a list of those which had been taught to the children and with which each was supposed to have been familiar, of three series of tone groups derived from the initial and final tonal patterns of the phrases contained in the song material for these grades, and of a musical phrase, the invention of the investigator.

A trial presentation of the testing materials was made to fifteen primary-grade pupils from another school and eighteen junior high school pupils. Results of the trial presentation guided the investigator in establishing a definite recording procedure and in the

final selection of the testing materials.

The recordings made by the subjects were transcribed to graphs arranged to show in semi-tone values the correct materials and each pupil's response. The pupils' response lines were compared to the correct melodic line and the variations were studied. Special attention was given to the classification of pupils by ability on the basis of the data, and to types of errors observed.

Conclusions on Tonality Apprehension

Introduction.--It was noted earlier that investigations of tonality apprehensions as such have been few in number. However, several studies have been reported on what can be considered as factors or elements of tonality apprehension. These have dealt with such questions as the ability of children to control pitch vocally, to sing intervals, musical motifs, phrases and songs, to recognize key alterations in familiar melodies, and to be influenced by the tonality of one song in the performance of a second song. In the present study the major questions raised relate to the classification and distribution of ability, the relationship of ability to age and grade placement, the types of errors made and their effect on tonality apprehension, the influence of melodic pattern on tonality, and the effect of lowering the pitch of songs on the ability of children who experience difficulty with vocal production. The following paragraphs summarize the evidence on these questions obtained by this study.

Classification and distribution of ability.--Two methods of classification of ability were used by this study. The first method considered each child's performance on a particular song chosen for

each grade. The second considered each child's performance on all songs sung by him. Both methods used the same criterion for the purpose of classifying ability, namely, evidence of the ability to establish and maintain tonality throughout the singing of an entire song. Three classes of ability were noted: some children established and maintained tonality (Group I), others established but failed to maintain tonality (Group II), and a third group could neither establish nor maintain tonality (Group III).

Classified on the basis of performing a particular song for each grade, 39 per cent of the pupils studied were capable of establishing and maintaining tonality, 33 per cent established but lost tonality, and 27 per cent failed to establish tonality. Considering each child's performance on all songs sung by him, 26 per cent maintained tonality, 43 per cent established but lost tonality, and 31 per cent failed to establish it. Since none of the studies reviewed used the same criterion of ability for purposes of classification, it was impossible to compare the distribution of ability found in this situation with that of other situations studied. Only one other investigation reported the use of a similar criterion. Williams, Sievers, and Hattwick used as a criterion of tonality feeling the ability to return to the key note after singing a phrase of a song. However, these investigators felt this criterion to be inadequate because, on the basis of this criterion alone, a monotone might make an excellent score.

The relationship of tonality apprehension to age and grade placement.--Research literature was found to be in general agreement that ability with respect to certain aspects of tonality increases with age. The present study found only a small significant correlation to exist

between tonality apprehension when measured as a unit and age and grade placement. There was considerable variation in ability in each grade and age level as well as considerable overlapping in ability from grade to grade and from age to age. However, pupils of the third grade classified in Group I on tonality apprehension sang with greater tonality precision than did the pupils of the same group from the other two grades. Pupils of the second grade sang with greater precision than did the pupils of this group of the first grade. While the differences were too slight to be statistically significant, the data seem to indicate that among children of superior ability in tonality apprehension there is a gradual advance in precision and accuracy in singing concomitant with chronological development.

That children with superior ability tend to improve with chronological development is normally to be expected. It might likewise be expected that all children, regardless of ability, would improve with chronological development. It is significant that this was not found to be the case in this situation. The evidence showed that children with inferior ability in the third grade were no better tonally than the children of the same group in the second and first grades. This would seem to imply that teachers of music can expect ability to improve as age increases only if there is something to improve upon in the first place, and that unless a child develops a fundamental concept of tonality early in his school life the chances are limited that he will make any improvement in the ability to sing with a feeling for tonality. How a feeling for tonality can best be developed is a question which this study makes no attempt to answer in a positive fashion. The study offers

evidence, however, to show that the usual type of class-room situation does very little in the way of training for tonality feeling for children of less than superior ability.

Of significance are the data showing the similarities that existed between the various ability groups regardless of grade level. Children in Group I in the first grade were more similar in ability to the children of the same group in the second and third grades than they were to the children of the second and third groups of the first grade. This would seem to imply that it would be possible to organize classes for music instruction on the basis of ability as well as by grade levels. Organization on the basis of ability would make possible: (1) the use of materials designed to correct specific weaknesses characteristic of less able children; (2) greater flexibility in time allotment; (3) advancement of each ability group at a rate of speed commensurate with ability; (4) the use of instructional procedures geared to the ability of each group; (5) the frequent checking of progress; and (6) the use of more carefully graded song materials.

Types of errors and their effect on tonality.--An analysis of the performance charts of the individual children revealed several types of tonal errors which they made in the performance of the song materials. These errors were studied to determine what, if any, effect they had on the ability to establish and maintain tonality. The errors noted included intonation errors, pitch errors, and errors made by the repetition of melodic materials out of correct order, the invention of new material, and the omission of tones.

Intonation errors.--Intonation errors occurred in singing flat or sharp on the beginning, the highest and the lowest tones, on

ascending and descending intervals, and in changing intonation on repeated tones.

Intonation as a factor of tonality apprehension was not investigated in any of the studies reviewed. The present study revealed that intonation errors have little effect on the maintenance of tonality with pupils who have the ability to establish tonality. Only three pupils of this group lost tonality because of intonation errors. In each of these cases the loss of tonality was due to faulty intonation on ascending intervals.

Intonation errors were not the major cause for the inability to establish tonality. While it was evident that children who were unable to establish tonality made many intonation errors, it was felt that these were of minor influence on tonal ability when compared with the influence of other types of errors which these children made.

Intonation errors were made more frequently on ascending intervals than on any other tonal sequence. Few errors were made on repeated tones.

Pitch errors.--Research on the factor of pitch has been limited largely to the study of children's ability to sing intervals and match tones in order to determine their range and tone matching ability. The results of the present study have shown that it is highly important for an understanding of the tonality apprehension of young children to study and analyze pitch in terms of its relation to tonality-feeling.

The performance charts of these children showed that two types of pitch errors were made: (1) The correct tonal relationship was not maintained between the tones of intervals; and (2) pitch was

changed in the singing of repeated tones. The pitch errors on intervals were of four types: Intervals were sung as repeated tones, were too small, were too large, or were sung in the opposite direction.

The ascending interval constituted the most difficult tonal pattern for these children in establishing and maintaining tonality. This has also been found to be true by several other investigators. Vance and Grandprey found the average accuracy for singing descending intervals higher than that for ascending intervals for pre-school children. Williams and associates found wide intervals and those demanding leaps to high pitch levels the most difficult. Drexler, in a study of nursery and kindergarten children, found ascending seconds more difficult than descending seconds. However, Jersild and Bienstock found that ascending and descending thirds were produced equally well by a group of seventy children ranging from thirty-one months to eight and one-half years of age.

Pupils with a well-developed sense of tonality were able to maintain tonality in spite of making pitch errors of all types. They also made fewer errors than did the pupils with less ability. This would seem to imply that tonality apprehension is more fundamental than the ability to maintain precise pitch relationships. However, the lack of a sense of pitch relationship may be a fair indication of weak tonality apprehension. At least the pitch errors made by the less able pupils of this group constituted the major symptoms of their inability to establish tonality. In addition, these errors indicated for these pupils several types of tonal weakness, the most prevalent of which was that of pitch relationship. This type, in combination with a weakness in melodic

direction, accounted for the inability of 66 per cent of the pupils of this group to establish tonality.

The singing of ascending and descending intervals too small accounted for the largest percentage of pitch errors. This information, along with that on the various types of tonal weakness evident in the singing of less able children, is significant for a program of corrective instruction and for the development of tonality.

Other types of errors.--Other types of errors revealed in the present investigation included the repetition of melodic motives out of correct order, the invention of new material, and the omission of tones. These errors were found to be either tonally non-defective or tonally defective. They were tonally defective when the making of such errors caused the loss of tonality. They were tonally non-defective if after making such errors a child maintained the established tonality.

The data showed that the making of errors of these types had very little effect on the ability to establish and maintain tonality. The stronger the sense of tonality the less it was affected by these errors.

Several pupils with a well developed sense of tonality forgot a portion of a song and invented melodic material to supplant that which was forgotten. They remained in the same tonality while doing so. On the other hand, the melodic materials invented by several pupils who had less tonality apprehension were characterized by a lack of melodic design and had no tonality basis whatsoever.

In songs which contained similar but not exact phrases, a few pupils repeated the first of such phrases instead of singing the second one correctly.

Influence of melodic pattern on tonality apprehension.--In

the present investigation an analysis was made of the melodic patterns of the songs in terms of the number and types of intervals, their range and pitch levels, and their general melodic configurations. With respect to the latter, it was found that the ability to establish and maintain tonality was considerably influenced by the general melodic pattern of the songs. The easiest songs were those which contained only a few narrow intervals. The most difficult songs were those which contained a preponderance of skips to both high and low pitch levels. These findings have implications for the selection and grading of song materials for these grades and point with some conclusiveness to the types of song materials which primary-grade children cannot perform effectively.

Some information has been reported by other investigators on the types of intervals found to be the most difficult for children to sing. This investigation adds to this research by reporting that ascending fourths, fifths, minor sixths, and minor sevenths, and descending fourths, fifths, minor sixths, and major thirds were found to be the most difficult for primary-grade pupils.

Relation of pitch level and range to ability of children.--

With regard to range and pitch level, it was observed that only the pupils with superior ability could approximate the actual range of tones and the average pitch of the songs as written. The superior children were also less variable as a group than were the less able children. The latter tended to lower the pitch and narrow the ranges of the songs. These results, which corroborate findings reported by Williams, Jersild and Bienstock, and others, seem to indicate a need for lowering the pitch of the songs and for the selection of songs with a narrower range, especially for

pupils without marked singing ability. Evidence on thirty pupils showed that lowering the pitch of songs materially benefited the performance of children in the two highest ability groups. Little advantage resulted for the less able children.

Conclusions as to song difficulty.--The evidence with regard to melodic pattern seemed to point to the conclusion that the difficulty of these songs was due more to their interval content and the placement of the range than to the range of semi-tones covered and the average pitch level. To illustrate, a song with a diatonically constructed melody having a range of fourteen semi-tones extending from C¹ to D² with an average pitch level of A¹ would be easier to perform than a song containing a large percentage of wide intervals with a range of twelve semi-tones extending from E¹ to E², and an average pitch level of G¹.

Conclusions on Tonal Memory

Tonal Memory.--In research on musical abilities, tonal memory has been regarded as significant from several points of view: as an attribute of musical people, as a means of testing musicality, and as an index to general ability in singing. Much of the research in tonal memory has used a judgment response method which, according to Mursell, is an unsatisfactory method of testing tonal memory.

Two measures of tonal memory were used in the present study. Tests were made of: (1) the ability to recall familiar songs, and (2) the immediate recall of dictated tonal materials consisting of a series of tone groups and a musical phrase. In both cases the children actually sang the test materials. In some earlier studies children have been asked to recall familiar songs. Tests of immediate recall of dictated

material for the purpose of ascertaining tonal memory ability have not been reported prior to the present study.

The ability to recall familiar songs.--As in the case of tonality apprehension, it proved possible to make an analysis in qualitative terms of the ability to remember the melodies of specific songs. Three ability groups were observed: some pupils sang the melodies precisely, some only directionally, and some without either precision or direction. Of these pupils 30 per cent were in the first group, 30 per cent were in the second and 40 per cent were in the third. These data compare favorably with those reported by Hattwick in a study of a group of children from four to ten years of age.

The immediate recall of tonal materials.--Whereas all of the 135 children were tested for ability to recall familiar songs, only fifty-eight children were tested for the immediate recall of tonal materials. These fifty-eight children were those selected by the music teacher as able to sing the ordinary songs of the primary-grade program. They included 15 pupils from the first grade, 22 from the second grade, and 21 from the third grade. The study of immediate recall was restricted to this selected group of singers, because the testing materials used demanded a degree of singing ability greater than that possessed by the other children of these grades.

The children used as subjects in this part of the study were requested to sing three series of tone groups of four, five, and six tones each, and a short musical phrase of thirteen tones. Their singing was recorded, and errors made were analyzed. The relationship of the ability to sing the tone groups to the ability to sing the phrase was also investigated.

Nearly all of the errors in the singing of the dictated tonal materials were made by singing incorrect tones. Errors consisting of the omission or addition of tones were negligible in number. This observation may suggest that children remember the length or general pattern of a tonal series more readily than specific tones or tonal relationships.

The subjects were more accurate on the four-tone series than on the five- and six-tone series. Accuracy tended to decrease as the number of tones increased.

Within this group of children chosen as singers, ability to recall dictated materials varied widely. In other words, some children may take longer than others to learn to sing a song with precision. The number of repetitions necessary for a successful performance may be indicative of ability in tonal memory.

The ability to sing tone groups correlated to a significant degree with the ability to sing a phrase. This would seem to imply that both abilities have elements in common and suggests the use of tone groups in training children for phrase memory.

Relationship of tonal memory to age and grade placement.--

A small but significant relationship was observed between performance on either test of tonal memory and age or grade placement. Wide variations existed on each age and grade level in this ability. However, there were fewer children in the lowest ability groups in the second and third grades than in the first, and ability was more evenly distributed in these grades.

The extent to which an ordinary classroom music program improves tonal memory has not been investigated, although evidence has

been presented by several investigators to show that tonal memory is highly susceptible to training. Various techniques have been used for training purposes, among them interval drills, short tone sequences, and the use of one- and two-phrase songs built on simple tonal patterns. The subjects of the present study had been given no special training for the development of tonal memory.

The relationship of tonality apprehension to tonal memory.--

The relationship of tonality apprehension to tonal memory has not been investigated prior to the present study. Several writers have assumed that the presence of one ability presupposes the existence of the other. Evidence obtained by this investigation disclosed a significant but moderate correlation between tonality apprehension and tonal memory when the latter was tested by the ability to remember the specific melodies of familiar songs. When tonal memory was tested by the immediate recall of dictated tonal materials the correlation, while statistically significant, was very low.

A finding which may have considerable significance is that children of the second and third grades who had poor tonality apprehension were also poor in tonal memory. This fact suggests that children who fail to develop tonality consciousness early in their school careers may be definitely limited in the development of other traits of musicality of a tonal nature.

General Conclusions and Implications

Introduction.--From the foregoing summary of results, it is evident that this investigation makes contributions to, and has implications, not only for the music education of primary-grade children.

but also for the psychology of child growth and development. Implications and contributions of particular significance in each of these fields of study are discussed in succeeding paragraphs.

Music education.--This investigation has shown that it is possible to classify objectively the musical performance of young children on at least two aspects of musicality (tonality apprehension and tonal memory) in more meaningful terms than those which have been hitherto employed. The commonly used terms of monotone, partial singer, and singer particularize no one aspect of musical ability and are therefore practically meaningless except as they are used to form the basis for a loose type of classroom organization for music instruction. On the other hand, the terms used by this study to characterize the three ability groups with respect to each aspect of musicality investigated are directly descriptive. In each instance, the term suggests a new focal point for the music education of these children.

The data of the study direct attention to certain specific tonality and tonal memory weaknesses characteristic of children on all levels of ability for each aspect of musicality investigated. By so doing, the data imply a need for remedial instructional techniques, and the use of certain principles to guide the selection and grading of materials, in order that appropriate musical experiences may reinforce the remedial techniques employed. A suggested plan of action for the remedial instruction of children of inferior tonality apprehension would call for: (1) the careful determination of physical and tonal weaknesses (faulty vocal production, limited range, poor pitch discrimination, hearing difficulties, speech defects.); (2) the formulation and use of teaching techniques to correct such difficulties; and (3) the use of

song materials adapted to the ability of the children to reinforce the corrective procedures being used and to enrich the musical experience of the children. The melodies of the songs would be narrow in range, mostly diatonic in construction, use only narrow intervals, and would avoid skips to both high and low tones. The pitch of the songs would be kept low and the range widened only as ability improved. Singing should be supplemented by other musical experiences, such as the playing of simple definite pitch producing instruments and frequent listening to (not the continuous singing with) the singing of children of superior ability. The songs would contain short phrases with frequent phrase repetition. The specific remedial techniques needed in this plan await further research.

It seems probable from the date of this study that unless a child develops a feeling for tonality he is not likely to show improvement in singing during the primary years. This finding implies a need for an early evaluation of the musical ability of each child, a thorough diagnosis of difficulties, and the use of such methods of organization and instruction as will eventuate in the improvement of children of weak ability and the further development of those who are superior in ability. This study raises a question as to the effectiveness of the usual type of music teaching situation in achieving the first of these goals. The fact that the subjects of the study were from a single school makes it impossible to answer this question. Additional research, perhaps of an experimental nature, should supply more definite information as to the types of situation that will be the most effective in achieving both goals. Several advantages were cited for the organization of instruction on the basis of ability groups rather than on the present basis of grade levels.

The present study has corroborated the findings of other studies and has made available additional evidence to form the basis for the establishment of certain principles to be used in the selection and grading of song materials for these grades. These data have characterized the types of song materials in terms of interval content, range, and average pitch level which children of these grades with varying amounts of tonality and tonal memory ability can perform effectively. However, additional research on these problems is needed.

The psychology of growth and development.--Some of the findings of this investigation relative to the musical growth and development of the subjects studied should be of interest to students of child growth and development. Earlier paragraphs have discussed the evidence on the development of the musical ability of musically superior children and the lack of development of musically inferior children. Another finding is that superior children seem to possess marked ability both in tonality apprehension and in tonal memory.

A study of the musical development of a group of children carried on, with frequent testing, throughout the first three years of schooling would supply significant evidence on this important aspect of child growth.

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APPENDIX A
MANUSCRIPT COPIES OF SONGS

Kangaroo

Far a-way lived a kan-ga-roo, Who ate so much that he
grew and grew; When he was lit - tle he hopped to bed, But
now he gives a big leap in - stead.

The Baker

"Who will buy my pies?" hear the bak-er say! "Pies, pies
buy my pies to - day."

Away In A Manger

A - way in a man - ger, no crib for a bed, The lit - tle Lord
Je - sus laid down His sweet head: The stars in the bright sky
looked down where He lay--The lit-tle Lord Je-sus a-sleép on the
hay.

Dinkey Donkey

Din - key don - key Going to the fair, Oh! Walk a mile,
rest a - while: When will he be there? Oh!

The Grasshopper

A grass - hop - per hopped to a red - bud tree, And
chirped, "Come a - way, come a - way with me! Come a -
way, come a - way, come a - way!"

America

My coun - try! 'tis of thee, Sweet land of lib - er - ty,
Of thee I sing; Land where my fa - thers died! Land of the
Pil - grims' pride! From ev - 'ry moun - tain side, Let free-dom
ring! -----

The Organ Man

Come, Come if you can! Hear the Or - gan man. Oh, he is
 sure to bring A mon - key on a string.

Fairy Fiddles

Sweet and clear, far and near, Fair - y fid - dles are
 play - ing; Sum - mer night, Stars are bright; You must
 fol - low the sound.

The Echo

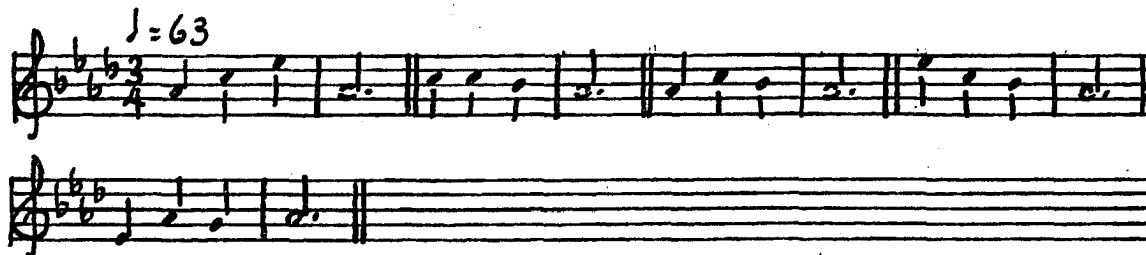
"Hoo!" . . . Some - one is call - ing me. "Hoo!"
 Plain - ly I hear. "Hoo!" Now he is far a - way; "Hoo!" .
 Now he is near.

APPENDIX B

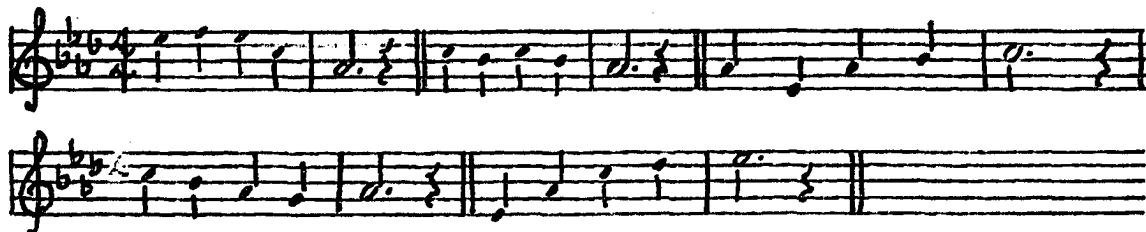
MANUSCRIPT COPIES OF THE TONE GROUPS

FOUR TONE GROUPS

$\text{♩} = 63$



FIVE TONE GROUPS



SIX TONE GROUPS

$\text{♩} = 83$



APPENDIX C

MANUSCRIPT COPY OF THE PHRASE



APPENDIX D

TABLE XLI

DISTRIBUTION OF ERRORS MADE ON THE
INTERVALS OF ALL SONGS SUNG BY THE
PUPILS OF THE FIRST GRADE

Types of Intervals	N	Group I		Group II		Group III		Total Errors	Total Possible Errors
		Er-rors	Pos-sible Errors	Er-rors	Pos-sible Errors	Er-rors	Pos-sible Errors		
Ascending									
Minor Second	5	12	42	18	32	37	40	67	114
Major Second	16	26	128	35	88	85	102	146	318
Minor Third	1		10	5	8	2	2	7	20
Major Third	3	3	28	9	24	24	26	36	78
Perf. Fourth	3	3	24	5	16	15	16	23	56
Perf. Fifth	1		10	2	8	2	2	4	20
Minor Seventh	1		10	5	8	1	2	6	20
Descending									
Minor Second	6	3	59	11	48	16	22	30	129
Major Second	29	27	265	44	208	111	158	182	631
Minor Third	5	5	38	14	24	29	30	48	92
Major Third	1	2	5			2	2	4	7
Perf. Fourth	1		10	3	8	1	2	4	20
Perf. Fifth	1	3	9	4	8	12	12	19	29
Unisons	20	3	178	10	136	39	110	52	424
Totals		87	816	165	616	377	526	628	1958

TABLE XLII

DISTRIBUTION OF ERRORS MADE ON THE
INTERVALS OF ALL SONGS SUNG BY THE
PUPILS OF THE SECOND GRADE

Types of Intervals	N	Group I		Group II		Group III		Total Errors	Total Possible Errors
		Er-rors	Pos-sible Errors	Er-rors	Pos-sible Errors	Er-rors	Pos-sible Errors		
Ascending									
Minor Second	9	3	87	6	86	18	23	27	196
Major Second	14	6	134	20	117	21	27	47	278
Minor Third	10	13	146	10	61	35	50	58	257
Major Third	2	4	16	6	16	1	1	11	33
Perf. Fourth	2	5	22	5	9	2	2	12	33
Perf. Fifth	3	6	29	13	19	1	2	20	50
Minor Sixth	1	5	13	1	3	1	1	7	17
Major Sixth	1	10	18	8	10	11	11	29	39
Minor Seventh	1	1	9	4	6	1	1	6	16
Descending									
Minor Second	16	11	162	21	119	20	30	52	311
Major Second	30	19	282	32	215	21	41	72	538
Minor Third	7	10	81	4	31	4	6	18	118
Major Third	3	5	33	7	16		2	12	51
Perf. Fourth	2	6	22	5	9	1	2	12	33
Minor Sixth	5	19	90	22	50	46	55	87	195
Unisons	26	10	265	6	185	10	48	26	498
Totals		133	1419	170	952	193	302	496	2663

TABLE XLIII

DISTRIBUTION OF ERRORS MADE ON THE
INTERVALS OF ALL SONGS SUNG BY THE
PUPILS OF THE THIRD GRADE

Types of Intervals	N	Group I		Group II		Group III		Total Errors	Total Pos- sible Errors
		Er- rors	Pos- sible Errors	Er- rors	Pos- sible Errors	Er- rors	Pos- sible Errors		
Ascending									
Major Second	7	7	94	23	95	36	60	66	249
Minor Third	5	1	68	25	87	38	48	64	203
Major Third	4	2	56	16	72	25	38	43	166
Perf. Fourth	7	10	92	58	107	62	65	130	264
Perf. Fifth	1	4	14	7	13	6	8	17	35
Descending									
Minor Second	4		54	31	72	33	38	64	164
Major Second	14	4	194	58	234	90	129	152	557
Minor Third	2		23	7	26	11	16	18	70
Major Third	3	8	42	11	39	22	24	41	105
Perf. Fourth	2	2	28	9	26	15	16	26	70
Perf. Fifth	3	2	40	13	51	24	29	39	120
Minor Sixth	2	5	24	17	30	19	20	41	74
Unisons	22	4	308	35	366	105	200	144	874
Totals		49	1042	310	1218	486	691	845	2951