AN INVESTIGATION OF THE PITCH-MATCHING ABILITIES OF FIRST GRADE CHILDREN

by

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ABSTRACT

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The primary purpose of this study was to investigate selected pitch-matching abilities in first grade children. Factors considered to be important to the development of these perceptual skills included sex, chronological age, home musical environment and singing ability.

Procedures

A 26-item battery - The Pitch Matching Abilities Tasks - was developed to collect the data for the study. The battery represented four different pitch-matching tasks. A special instrument, the Pitch-in-a-cans, was also devised for use in the study. These 'cans' were battery-powered variable tone generators that produced individual sounds (pitches) when picked up. They allowed for a simple manipulation of sounds by the subjects. All of the items in the battery were designed for response using the Pitch-in-a-cans and therefore did not require a verbal response.

The forty first-grade subjects used in the study were randomly selected from four elementary schools in Michigan.

Twenty girls and twenty boys comprised the sample. Due to absenteeism four of the forty subjects did not complete all of the tasks.

Conclusions

On the basis of the data analysis of the results of this study, the following conclusions were drawn:

1. No difference in auditory perception performance ability was found at the first grade level according to sex.

2. No difference in auditory perception performance ability was found at the first grade level according to chronological age.

3. No difference in auditory perception performance ability was found at the first grade level according to home environment (musical or non-musical). The determinants for a musical home environment were questionable, however, and necessitate further research.

4. The ability to match individual pitches with a vocal response was a significant factor in the manipulation of sounds to form musical phrases.

5. There is a need for more research regarding the development and use of non-verbal, manipulative measures for the identification of perceptual abilities in young children.

To

Jessica

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CHAPTER ONE

THE PROBLEM

Introduction

Music in the elementary school represents a myriad of singing, playing, moving, creating and listening activities for young children. Inherent in these activities is the development of gross and fine motor abilities, coordination and perceptual skills, and the opportunity for peer interaction, self-expression and simple enjoyment. Though all of these objectives are important at the elementary level, the most significant contribution that music can make to a child's early growth and development lies in the area of sensory perception development. A popular music textbook for classroom teachers states that:

> Music is sound and it communicates its message aurally. An individual will become a sensitive performer or responder only if he listens to himself and to others with discrimination. This ability is a learned skill which must be taught as carefully as any other skill.[1]

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[1]Bjornar Bergethon and Eunice Boardman, Musical Growth in the Elementary School, Third Edition, (New York: Holt, Rinehart & Winston, 1975), p. 14.

The essence of this statement reveals the ideal nature of music for teaching children to become attentive, yet discriminating listeners. This 'skill' represents an ultimate goal of all education, elementary education in particular. Some of the ways that perceptual skills are identified and developed through music will be discussed in this study.

The Problem

Sensory perceptions in music include the visual, tactile, vocal and aural. Of these, the aural nature of music tends to dominate. Auditory perception deals with an awareness to aural stimuli. This awareness usually involves two processes: (1) the realization of the presence of sound and (2) a discrimination of some of the features of the realized sound. The development of an auditory perception hierarchy in young children has been of interest to researchers and educators for years. The identification of a similar sequence is relevant to music educators since aural understandings are considered necessary before the child can successfully begin to engage in activities which involve musical notation. . .[2]. Furthermore, it seems necessary to identify certain stages of auditory perceptual development

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[2]Robert G. Petzold, Development of Auditory Perception of Musical Sounds By Children in the First Six Grades, CRP No. 766, (June 30, 1960), University of Wisconsin, p. 3.

if the sequence and content of instructional programs are to be properly geared to meet the abilities of young children.

Music may be defined as sound, organized within time. Musical sound, or tone, possesses four properties: pitch, timbre, duration, and loudness. The basic elementary music program focuses on all the aspects of tone; however, the aspect of pitch appears foremost in classroom instruction.

Pitch refers to the perceived highness or lowness of a tone.[3] The components of musical pitch are four: frequency, intensity, waveform and duration. The component of frequency relates closest to the elementary music program objectives relating to the characteristics of musical pitch. The frequency of a pitch refers to the number of complete cycles which occur in a sound source in one second.[4] Frequency is responsible for the perceived highness or lowness of a sound. A primary perceptual task in elementary music involves an awareness of high and low sounds. A task related to this ability, but more basic to a perceptual hierarchy of pitch perception seems to be an awareness of same and different sounds. Once sounds are differentiated as either same or

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[3]Robert W. Lundin, An Objective Psychology of Music, (New York: Ronald Press Co., 1953), p. 17.

[4]Wilmer T. Bartholomew, Acoustics of Music, (Englewood Cliffs, N.J.: Prentice-Hall, 1942), p. 5.

different, a second perceptual decision (e.g. high vs. low), could apply. It is to the former level of auditory perception development -- the discrimination of same and different sounds -- that this study will be addressed.

The auditory perceptual ability that relates to the differentiation of like or unlike pitches (same or different) is termed pitch discrimination. Seashore defined pitch discrimination as the ability to hear small differences in pitch.[5] Since individuals, and especially children, differ in their ability to discriminate pitch differences, much research has set out to determine the difference limen for certain age levels. (A difference limen (DL) is the frequency change in a tone which is just perceivable fifty percent of the time.[6]) Though this study is not directly interested in identifying this variable, some pertinent data will be made available.

A more advanced degree of pitch discrimination skill, namely, pitch matching, requires not only the ability to hear differences in pitch but also to produce or manipulate pitches in such a way that any difference is eliminated. For example, a child could be given a set of five resonator bells, three being the same pitch the remaining two being

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[5]Carl E. Seashore, Psychology of Music (New York: McGraw-Hill, 1938), p. 55.

[6]Lundin, p. 20.

different. A pitch matching task would be to group the 'like' sounds and to remove those sounds that did not belong. (This is the basic principle underlying this study.)

Purpose

The primary purpose of this study is to investigate selected pitch matching abilities of young children. Since most children are not exposed to a formal music education until their entry into elementary school this study will aim to include that population.

In the state of Michigan elementary general music begins either in kindergarten or first grade. This is dependent upon school size, curricular concerns, staffing and budget. An elementary general music program usually represents a broad, varied curriculum involving all the aspects of music. It is designed for total student body participation and is usually taught by a music specialist. For the purpose of this study the first grade level was selected. This was done for two reasons. Since the testing was to be done in the morning and kindergarten children usually attend school for half a day (morning or afternoon), the afternoon kindergartners would not have been able to participate. Second, most kindergarten teachers include music with their everyday activities and it is not until the first grade that the music specialist is responsible for the musical education of the children.

Using first grade children as subjects, this study will try to determine a sequential ordering of auditory perception skills as measured by pitch matching tasks. The study will investigate the degree of vocal control/ability present in these children and its relationship to auditory perception skill. Other factors to be analyzed include the effect the child's sex, chronological age, and home environment, have on various pitch matching tasks.

The thrust of this study relies on the use of a totally aural, non-verbal, manipulative device for the measurement of auditory perception skills. This instrument has the ability to produce like and unlike sounds (pitches) without providing any visual clues (size, shape, color) to aid the child. The instrument is easy to manipulate and is extremely attractive to young children. The Pitch-in-a-cans meet this description.

In the past pitch perception and pitch matching abilities of young children have been identified by one of two methods:

1) the child hears a pitch and reproduces it vocally.
2) the child hears two successive pitches and responds (written, verbal, other) Same or Different.

The present study questions the use of these response modes with young children. The singing response requires a certain degree of vocal control/ability. This level may not be developed in the first grade child. The second response necessitates the use of a label for an aural stimulus.

Research has found that young children often become confused with terminology. Excessive directions usually result in misunderstandings with simple tasks. Therefore, a response free of both vocal ability and verbalization seems appropriate for this level. The use of non-verbal measures has been minimal but highly successful. They deserve more development and use in experimental studies with young children. As Bergethon states:[7]

> Active pupil exploration, where the child actually manipulates and experiments with stimuli, is superior to methods that provide only for verbal responses.

The non-verbal instrument represented by the Pitch-in-a-cans allows for this manipulation and experimentation.

Hypotheses

This study intends to identify specific levels of auditory perception skill (through pitch-matching tasks) in first grade children. Related to these levels are the child's sex, chronological age, and home musical environment, and degrees of vocal ability/control. Specifically, the study hopes to answer the following questions:

1. Is sex responsible for differences in auditory perception skills in first grade children?
2. At the first grade level, is a child's chronological age responsible for differences in auditory perception skills?

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[7]Bergethon, p. 15.

3. Is a child's home musical environment responsible for differences in auditory perception skill?

4. Does the degree of vocal control/ability in first grade children affect their auditory perception skill?

5. Does the ability to sing a familiar song at the first grade level necessarily imply a perception of that song?

6. Do the Pitch-in-a-cans provide a new and useful means for identifying levels of auditory perception skills (as measured by the Pitch-Matching Abilities Tasks) in first grade children?

Based on the research questions stated above the following hypotheses represent the interests of this study:

H_1: There is a relationship between a first grade child's sex and auditory perception skill.

H_2: There is a relationship between a first grade child's chronological age and auditory perception skill.

H_3: There is a relationship between a first grade child's home musical environment and auditory perception skill.

H_4: First grade children will perform at different levels on measures of vocal control/ability related to pitch-matching skill.

H_5: First grade children will differ in their ability to sing a familiar song and to perceive it using the Pitch-in-a-cans.

H_6: There is a relationship between a first grade child's auditory perception skill as measured by a vocal response and an overt response (Pitch-in-a-cans).

H_7: First grade children will perform at different levels on auditory perception (pitch matching) tasks using the Pitch-in-a-cans.

H_8: Using the Pitch-in-a-cans, the Pitch-Matching Abilities Tasks will identify different levels of auditory perception skill.

H_9: There is a difference between a first grade child's ability to perceive individual tones and tonal patterns.

Significance of the Study

Pre-school and early childhood education have generated much interest in recent years. Project Head Start, various Title programs and an increase of Montessori and related educational approaches have perpetuated the need for research studies involving young children. Of particular concern is how children learn -- and when? This study is concerned with the identification of a developmental hierarchy of auditory perceptual skills, in first grade children.

A publication by the Music Educators National Conference (MENC) entitled Music in Early Childhood[8] discusses certain developmental stages in children between the ages of three and five that relate to musical skill. With regard to auditory perception ability, a child at age five should be:[9]

1) growing in ability to discriminate between pitches

2) reproducing short melodic patterns with increasing accuracy when singing or playing

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[8]Barbara L. Andress, Hope M. Heimann, Carroll A. Rinehart, and E. Gene Talbert, Music in Early Childhood, (Washington, D.C.: Music Educators National Conference, 1973).

[9]Ibid., pp. 21-2.

3) becoming more accurate in matching tones because of increased tonal memory.*

*Tonal memory refers to short term memory - a memory system that is of short duration, lasting only seconds.[10]

Since this study will involve first grade children (usually age six), these same behaviors should be identifiable.

To date, various methods of identifying these perceptual behaviors have been piloted: a singing response - Updegraff (1937), Petzold (1960); a verbal/written response - Bentley (1966), Duell and Andersen (1967), Zwissler (1971); assorted non-verbal responses - Williams (1975), Van Zee (1976), Hair (1977). Petzold reported that lack of vocal control does not necessarily reflect a corresponding lack of aural understanding.[11] With regard to written/verbal responses a study by Andrews and Diehl (1967) reports that perhaps children do perceive differences in pitch but respond poorly due to their inability to use traditional labels correctly.[12] Concurrently, Hair found that through the use of

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[10]Kermit Wells Holly, Jr., "An Experimental Investigation of the Effect of Selected Factors on the Short-Term Retention of Pitch Sequences", (Doctoral Dissertation, Michigan State University, 1977), p. 14.

[11]Petzold, p. 110.

[12]Frances M. Andrews and Ned C. Diehl, Developing a Technique for Identifying Elementary School Children's Musical Concepts, Final Report BR 5-0233, (September, 1967), Penn State University, p. 86.

a non-verbal response mode, for pitch direction identification, first grade children could perceive differences in tonal patterns and could match directional patterns without being able to verbalize the concept. . . using traditional music terminology.[13] Non-verbal, overt types of measures seem to be more appropriate with this age level.

Increased knowledge about how children learn is vital to any area of development, especially auditory perception. The ways to identify and 'bring out' these states must be under constant revision and scrutiny. Too often it is the measure that is inappropriate - not the ability being measured. As Petzold states:[14]

> Aural understanding, which is a reflection of accurate auditory perception, results from thinking and not mechanical imitation; from judgments made independently by the child and based on his understanding of basic musical concepts and not judgments made <u>for</u> the child by someone else.

Teaching effectiveness depends on how successfully a teacher presents material at a level comprehendable by the child. To be able to identify certain levels of auditory perception skill will better equip the music teacher to plan more realistically and teach toward attainable goals.

Several other factors seem to have an affect on auditory perception skill. These include a child's sex, age and

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[13]Harriet I. Hair, "Discrimination of Tonal Direction on Verbal and Non-Verbal Tasks By First Grade Children", <u>Journal of Research in Music Education,</u> Vol. 25, No. 3 (Fall, 1977), pp. 197-210.

[14]Petzold, p. 111.

home musical environment. Kirkpatrick (1968) found a significant relationship between a young child's home musical environment and his/her ability to sing.[15] Updegraff (1937) found that the ability of children to reproduce three, four, and five-note phrases increases with age.[16] Several studies reported a strong relationship between singing ability and auditory perception skill. Few studies have found significant relationships between auditory perception skill and sex in first grade children, however.

In summation this study plans to measure first grade children on various auditory perception tasks (pitch-matching skills) using a newly-developed, completely aural instrument that allows for easy manipulation of sounds by the subjects. Though a vocal response will not be required, its inclusion will hopefully provide additional information as to the coincidental development of perceptual and singing skills. Factors of sex, age and home musical environment will also be investigated.

Definition of Terms

The following terms occur at some time within the body of this study and will assume these definitions:

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[15]William C. Kirkpatrick, Jr., "Relationships Between the Singing Ability of Prekindergarten Children and Their Home Musical Environment", (Doctoral Dissertation, University of Kansas, 1968).

[16]Ruth Updegraff, Louise Heiliger, and Janet Learned, "Studies in Preschool Education I", University of Iowa Studies in Child Welfare, Vol. 14, (Iowa City: University of Iowa Press, 1937), p. 118.

auditory perception - the ability to hear and respond to musical sound (pitch)

home musical environment - musical experiences that occur regularly in the home (e.g. singing-parental, sibling, family; instrument playing-parental, sibling, individual; listening to music; attendance at musical events)

individual tones - single sounds (pitches)

pitch discrimination - the ability to hear differences between pitches

pitch matching - the ability to hear difference between pitches and to isolate these differences from pitches that are alike.

short term memory - that memory which sustains sounds for only seconds.

singing ability - the level at which a child can: 1) match individual tones vocally, 2) match simple tonal patterns vocally, and 3) sing familiar songs recognizably.

tonal patterns - groups of two to four different sounds (pitches), sounded successively and derived from children's songs (e.g. E,D,C representing the initial configuration in "Three Blind Mice")

Overview

The remainder of this study is divided into four chapters and several Appendices. Chapter II contains a Review of Related Literature. Chapter III deals with the Design of the Study. Chapter IV presents an Analysis of the Data and Chapter V comprises both the Summary and Recommendations for Future Research. Appendices contain documents, tables and relevant data from the study.

CHAPTER TWO

REVIEW OF LITERATURE

Introduction

Auditory (pitch) perception skill demands both a highly developed sense of discrimination competency and conceptualization ability. Auditory (pitch) discrimination is the process of differentiating aural stimuli. Conceptualization, according to Bergethon, is the means by which an individual organizes his sensory perceptions. As a concept occurs at more and more perceptual levels (seeing, hearing, tasting, smelling, touching), conceptualization occurs more readily.[1] When dealing with the auditory perception skill of young children, the levels of discrimination and conceptualization ability are at the early stages of formation.

During early childhood, musical skills center around moving, manipulating, singing and playing of instruments. All of these skills represent overt, non-verbal types of

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[1]Bjornar Bergethon and Eunice Boardman, Musical Growth in the Elementary School, Third Edition (New York: Holt, Rinehart & Winston, 1975), p. 15.

activities. Concurrently, the 'learning' that accompanies these skills usually involves limited discriminating, ordering, organizing, and improvising through musical sound. Therefore, if an instrument were devised so as to allow young children to manipulate musical sounds (pitches) for discrimination and conceptualization purposes, this skill would be representative of a fundamental musical ability that would aid in the identification of auditory perception skill in young children.

Following the theoretical foundations of this study, three specific areas were defined as topics for a review of related literature. They were: 1) developmental levels of auditory perception skill in young children; 2) the measurement of pitch perception (discrimination); 3) modes of response used for measuring auditory perception skills in young children.

Auditory Perceptual Development

The identification of musical abilities in children has been the object of debate for years. The advent of the Seashore Measures of Musical Talent[2] in 1919 initiated a theoretical battle that is still being waged. That is, does musical ability represent one distinct talent or a combination of several? Regardless of the position held, however, one

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[2]Carl E. Seashore, Seashore Measures of Musical Talent (New York: Columbia Phonograph Co., 1919).

'area' that is included in many measures of musical ability is auditory (pitch) perception skill. Bentley believes that the basic musical abilities are pitch discrimination, tonal memory and rhythmic memory.[3] Standardized measures of musical aptitude that contain tests in the areas of pitch discrimination and tonal memory include Seashore,[4] Wing,5 Drake,[6] and Bentley.[7] That auditory perception skill is basic to the development of a level of musical awareness and appreciation seems logical. An aural art demands aural skill for interpretation. Therefore, an identification of some levels of auditory perception skills is pertinent to a study in music education. Music education is defined as the study of the nature of and modification of human music behavior.

One way to describe our environment is that it represents a conglomeration of sounds. It is not long after birth

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[3]Arnold Bentley, "Measurement and Development of Musical Abilities", Journal of Research in Music Education, Vol. 17, No. 1 (Spring, 1969), p. 43.

[4]Seashore.

[5]Herbert Wing, Standardized Tests of Musical Intelligence (Sheffield, England: City of Sheffield Training College, 1958).

[6]Raleigh Drake, Drake Musical Aptitude Tests (Chicago: Science Research Associates, 1954).

[7]Arnold Bentley, Measures of Musical Abilities (London: Harrap, 1966).

that a young infant discovers that his cries and coos elicit different responses from his parents.[8] During early childhood (ages 3 to 5) a child experiences sound through speaking, singing, listening and playing. Imitations of aural stimuli (e.g. sirens, horns) are abundant during play. There is not a specific age when children begin to discriminate aurally between sounds. Some research has shown, however, that a child in a musically rich environment begins to develop the ability to describe sound at about age four.[9]

The discriminatory process in auditory perception skill involves a comparison of sounds. Research studies question whether or not this process begins with the simple task of discriminating like and different sounds or the more complex process of discriminating from a group of sounds. Though it seems that the former identification process (single, like sounds) would appear easier for young children, Shuter points out that in the experiments of Wing[10], recognition of the shape of longer tonal patterns preceded the identification of individual tones.[11] A study conducted by Boardman (1964) with kindergarten children also supported this contention.

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[8]Barbara L. Andress, Hope M. Heimann, Carroll A. Rinehart, E. Gene Talbert, Music in Early Childhood (Washington, D.C.: Music Educators National Conference, 1973), p. 5.

[9]Ibid., p. 20.

[10]Herbert Wing, "Tests of Musical Ability in School Children", (Masters Thesis, London University, 1936).

Auditory perception skill has been related to vocal ability (singing) and oftentimes measures of auditory perception require vocal responses. If these abilities are related, they might develop along similar levels. Seashore listed a developmental sequence of vocal abilities as follows:

1) reproduction of a tone,
2) control over fine changes of pitch or voluntary control,
3) control over musical intervals and. . . the singing of a melody with a memory for a given sequence of tones.[12]

This list rank orders single tones, pairs of tones and finally groups of tones with respect to vocal ability development. Studies by Williams (1935) and Drexler (1938) reported that the immediate reproduction of three-note patterns was as easy as producing a single tone.[13] Both studies involved preschool-aged children. Therefore a first level ability, whether single tone or tonal pattern matching, was never clearly identified.

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[11]Rosamund Shuter, The Psychology of Musical Ability (London: Metheun & Co., Ltd., 1968), p. 68.

[12]Carl E. Seashore, The Psychology of Musical Talent (New York: Silver Burdett, 1919), p. 288.

[13]Harold M. Williams, Clement H. Sievers and Melvin S. Hattwick, "The Measurement of Musical Development", University of Iowa Studies in Child Welfare, Vol. VII, No.1, 1932, p. 68.

The factor of home environment demands attention when investigating auditory perception skills. Studies in this area have been few. Many studies have shown the importance of music background to music development and achievement. For example, Kirkpatrick found significant relationships between the home environment of a preschool child and his/her singing ability.[14] A study by Petzold (1960) indicated that an increase in age had a positive effect on auditory perception skill, up to about age nine.

Pitch Discrimination

As defined in Chapter I, pitch discrimination is the ability to perceive (aurally) differences in sounds. In recent years several studies have sought to investigate the discriminatory abilities of young children. These studies have focused on identifying the difference limen (smallest discernable difference) for young children. Bentley[15], in piloting a pitch discrimination test with students ages 9 to 11, used the semi-tone as the smallest interval to discriminate. A review of the data indicated that 60% of those tested correctly discriminated the minor second interval. All other intervals enjoyed higher percentages of correctness.

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[14]William C. Kirkpatrick, Jr., "Relationships Between the Singing Ability of Prekindergarten Children and Their Home Environment", (Doctoral Dissertation, University of Southern California, 1962).

[15]Arnold Bentley, Musical Ability in Children and Its Measurement (London: Harrap & Co., 1966), p. 63 .

Conversely, a study by Williams (1975) found that 50% of the subjects in his study (grades K-2) could not identify the interval of a semi-tone correctly.[16] Studies by Gesler (1958) and Duell and Andersen (1967), that also used primary grade children, noted that as the size of the interval to be discriminated decreased, there was a general tendency for the percentage of error to increase.[17] They clearly indicated age to be an influencing factor in pitch discrimination ability.

The improvability of pitch discrimination skills has received much attention. This is probably due in part to the staunch position of Seashore and his theory of physiological limit. This theory states that pitch discrimination skill does not vary with age or training.[18]

> It seems probable that just as the physical eye of a child at the age of three is as keen as it ever will be, so the pitch sensitiveness in the ear probably reaches its maximum very early. . . . The physiological limit for hearing pitch does not improve with training. Training, like maturation, results in the conscious recognition of the nature of pitch, its meaning and the development of habits of use in musical operations.[19]

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[16]David B. Williams, "Children's Identification of Melodic Pitch Motion Effects of Initial Proficiency, Interval Size and Direction, and Durational Variation", Technical Note, Southwest Regional Laboratory, Los Alamitos, California, 1975, p.42.

[17]Orpha K. Duell and Richard C. Anderson, "Pitch Discrimination Among Primary School Children", Journal of Educational Psychology, Vol. 58, No.6, 1967, p. 317.

[18]Ruth F. Wyatt, "The Improvability of Pitch Discrimination", Psychological Monographs, No.58, 1945, p. 1.

[19]Carl E.Seashore, The Psychology of Music, (New York: McGraw-Hill, 1938), p. 58.

Research studies, using both children and adults as subjects, have revealed that certain pitch discrimination skills can be improved. These include F.O. Smith[20], Wolner and Pyle[21], Cameron[22], Capurso[23] and Wyatt[24]. As reported in Wyatt:

> Evidence of improvement in pitch discrimination may be found in every investigation reported. Although training did not eradicate individual differences and there were instances where no improvement occurred, in general the data show reduction in the range of differences and a shift to a better level of performance.[25]

Relationships between singing ability and pitch discrimination skill have been noted by researchers. Myers cites that reasons for poor singing ability in children include poor pitch discrimination (ability), a low speaking

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[20]F.O. Smith, "The Effect of Training in Pitch Discrimination", Psychological Monographs, Vol. 16, No. 69, 1914, 67-103.

[21]Manuel Wolner and W.H. Pyle, "An Experiment in Individual Training of Pitch-Deficient Children", Journal of Educational Psychology, Vol. 24, 1933, pp. 602-608.

[22]E.H. Cameron, "Effects of Practice in the Discrimination and Singing of Tones", Psychological Monographs, Vol. 23, No. 100, 1917, pp. 159-180.

[23]Alexander A. Capurso, "The Effect of An Associative Technique in Teaching Pitch and Interval Discrimination", Journal of Applied Psychology, Vol. 18, 1934, pp. 811-818.

[24]Wyatt, pp. 1-56.

[25]Ibid., p. 28.

voice and a lack of musical background.[26] A study by Zwissler (1971) involving first grade children found a significant difference in the pitch discrimination skills between subjects identified as accurate singers and those identified as inaccurate singers.[27] Concurrently, an investigation by Boardman of the vocal development of young children (preschool) concludes that the development of motor control and pitch discrimination may be factors in the development of singing ability.[28] Petzold cites the studies of Williams (1932), Jersild and Bienstock (1935) and Drexler (1938) to support this premise. Gould, however, argues that all children who can hear can perceive musical sound. The common problem with the uncertain singer is that of being unable to manipulate the voice so as to match musical sounds.[29]

Pitch matching ability is closely related to pitch discrimination skill. Differentiation of sounds must occur

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[26]Louise K. Myers, Teaching Children Music in the Elementary School (New York: Prentice-Hall, Inc., 1961) p. 49.

[27]Ruth N. Zwissler, "An Investigation of the Pitch Discrimination Skills of First-Grade Children Identified as Accurate Singers and Those Identified as Inaccurate Singers", (Doctoral Dissertation, University of California, 1971).

[28]Eunice L. Boardman, "An Investigation of the Effect of Preschool Training on the Development of Vocal Accuracy in Young Children", (Doctoral Dissertation, University of Illinois, 1964).

[29]Oren A. Gould, Developing Specialized Programs for Singing in the Elementary School, Final Report, Project No.5-241 (August, 1968), Western Illinois University.

prior to the matching of a single sound or pattern of sounds. If a vocal response is desired as the indicator of matching ability, the range of the pitches must be appropriate to the age and vocal span of the subject. Though early research believed the normal range of a young child's singing voice to be quite high (i.e., D^4 to E^5)*, Updegraff found the median singing range for five-year old children to lie between A^3 and A^4.[30] This range coincided with the findings of Jersild and Bienstock[31] and Hattiwick.[32] Bergethon qualifies this range by pointing out that vocal ranges of some children may only contain five tones, usually the pitches D^4 to A^4.[33] This limited range of vocal ability would partially explain poor discrimination skill, if the two variables were related.

Response Techniques With Young Subjects

Young children are adaptable and yet susceptible to changes in their surroundings. The presence of strangers

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*See The Materials of Music Composition, Book I: Fundamentals, 1978, H. Owen Reed and Robert G. Sidnell, p. 62.

[30]Ruth Updegraff, Mary Elizabeth Keister, Louise Heiliger, Janet Learned, "Studies in Preschool Education I", University of Iowa Studies in Child Welfare, Vol. XIV, 1937, p. 120.

[31]Arthur T. Jersild and Sylvia Bienstock, "A Study of the Development of Children's Ability to Sing", Journal of Educational Psychology, Vol. 25, No. 7 (October, 1934) pp. 481-503.

[32]Williams, Sievers, et al.

[33]Bergethon and Boardman, p. 13.

often causes shyness or fear to perform whereas a new object or toy often stirs imagination and interest. Similarly, young children tend to lose interest quickly, once the initial impact is over. For these reasons, continual variety in educational and recreational experiences is encouraged when working with young children.

Methods of response that have been used by researchers with young subjects have too often neglected to consider the attention span and interest level of their subjects. In order for a measure to be reliable it must maintain the interest of the subject.

Two methods of response for the measurement of pitch perception abilities have dominated research projects. They are verbal responses and vocal (sung) responses. Verbal responses usually involve the labelling of a tone or pair of tones with a verbal descriptor. Such terms as higher-lower, same-different and up-down are representative of descriptors used in pitch perception measurement. To young children, these labels have little relation to musical sound.[34]

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[34]Harriet I. Hair, "Discrimination of Tonal Direction on Verbal and NonVerbal Tasks by First Grade Children," Journal of Research in Music Education, Vol. 25, No. 3 (Fall, 1977), p. 197.

Studies by Williams[35], Jeffrey[36], Andrews and Diehl[37], and Taebel[38] support this claim. McGinnis (1958), in attempting to adapt several portions of the Seashore Measures of Musical Talent battery for use with young children (preschool), changed the terms 'higher' and 'lower' to 'Baby bear' and 'Daddy bear'. The children were then asked to listen to an aural stimulus and tell who spoke the last note - the baby bear or the daddy?[39]

A study by Zwissler (1971) that used first grade children, taught the terminology of 'up' and 'down' as related to pitch perception prior to the measurement. It reported that children still relied on other terminology,

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[35]Melvin S. Hattwick and Harold M. Williams, "The Measurement of Musical Development II", University of Iowa Studies in Child Welfare, Vol. XI, No. 2, 1935.

[36]Wendell E. Jeffrey, "Variables in Early Discrimination Learning: II. Mode of Response and Stimulus Difference in the Discrimination of Tonal Frequencies", Child Development, Vol. 29, no. 4, December, 1958, pp. 531-537.

[37]Frances A. Andrews and Ned C. Diehl, Developing a Technique for Identifying Elementary School Children's Musical Concepts, Final Report BR 5-0233, (September, 1967) Pennsylvania State University.

[38]Donald Taebel, "The Effect of Various Instructional Modes on Children's Performance on Music Concept Tasks" Reported in Harriet I. Hair.

[39]Esther McGinnis, "Seashore's Measures of Musical Ability Applied to Children of the Pre-School Age", American Journal of Psychology, Vol. 40, 1928, pp. 620-623.

other than that specified, during the testing.[40] A study by Hitchcock (1942), reported by Williams (1975), allowed children to use their own labels to identify pitch motion, i.e., bigger-smaller, lighter-heavier, etc. However, Hitchcock did not find significant differences in interval discrimination as a result of the label used.[41] In support of the use of verbal responses for pitch discrimination skills, Williams reports:

> Even though some research has suggested that labeling difficulties may occur in pitch identification tasks, the majority of the findings indicate that with appropriate cues and pretraining the majority of young children can use the consensual labels moving up-down, or higher-lower for pitch tasks. With more research on children below the age of six, however, labeling may prove to be a significant factor.[42]

The second response mode common to pitch perception/matching studies was a vocal or sung response. This method was used exclusively in a longitudinal study by Petzold (1960). The author notes, however, that a lack of vocal control. . . does not necessarily reflect a corresponding lack of aural understanding.[43] A study by Hattiwick and Williams

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[40]Zwissler.

[41]A. Hitchcock, "The Value of Terminology in Children's Descriptions of Changes in Pitch Direction", Unpublished Master's Thesis, reported in David B. Williams.

[42]David B. Williams, p. 5.

[43]Robert G. Petzold, Development of Auditory Perception of Musical Sounds by Children in the First Six Grades, CRP No. 766, University of Wisconsin, June 30, 1960, p. 110.

(1935) utilized a vocal response mode qualifying that a certain degree of voco-motor control was necessary. An earlier study by the same researchers reported that "not more than four out of ten children at this level (age five) are testable for pitch discrimination either verbally or by interval singing."[44]

Related to the vocal mode of response was the source which generated the aural stimulus. A thorough study by Clegg (1966) compared the vocal responses of first grade children to pitches generated from the following aural stimuli: male and female voice, piano, autoharp, pitch pipe, song bells, flutophone, and soprano recorder. Findings revealed that the response to the female voice was significantly higher than other stimuli.[45] Updegraff (1937) supported this contention for preschool children as well.[46]

Various types of non-verbal response modes for measuring pitch perception skills have been used rather successfully with young children. Williams (1935) designed and implemented a set of chimes similar to the Montessori bells; Jeffrey (1958) and Williams (1975) used a button-push

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[44]Williams, Sievers, et al., p. 68.

[45]Beth W. Clegg, "A Comparative Study of Primary Grade Children's Ability to Match Tones", (Master's Thesis, Brigham Young University, 1966), p. 67.

[46]Updegraff, Keister, et al., p. 118.

mechanism; Van Zee (1976) utilized a piano keyboard for subject response and Hair (1977) used resonator bells as indicators for tonal direction differentiation. Van Zee found that kindergarten children appear to be more efficient in demonstrating an understanding of duration of tones and rhythm patterns (through an overt, keyboard response) than in verbally describing them.[47] The study by Hair found that subjects scored significantly higher on the non-verbal tasks of playing tonal patterns on resonator bells than on verbal tasks. "Many of these children could perceive differences in tonal patterns and could match directional patterns without being able to verbalize the concept using traditional music terminology."[48] Clearly, the development and use of non-verbal, manipulative measures to identify pitch perception skills in young children merits further investigation.

Summary

The review of literature cites an interest, on the part of educators and researchers, toward the identification and measurement of auditory (pitch) perception skills in young children. A hierarchy of developmental stages exists for vocal ability, but this sequence has not been substantially linked with pitch perception ability.

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[47]Norma Van Zee, "Responses of Kindergarten Children to Musical Stimuli and Terminology", Journal of Research in Music Education, Vol. 25, no. 1 (Spring, 1976), p. 20.

[48]Hair, p. 197.

Pitch discrimination/matching abilities have been investigated extensively. The center of focus for the majority of these studies has been the identification of a difference limen (DL) in young children. Studies by Duell and Anderson (1967) and Williams (1975) designate the minor second as the smallest discernable interval for subjects aged six and up. Petzold (1967) and Boardman (1964) have reported a relationship between singing ability and pitch discrimination, though a deficiency in one does not necessarily infer deficiencies in both.

Studies by Hair (1977), Van Zee (1976) and others report the significant place for the implementation of non-verbal measures for pitch perception measurement in young children. The superiority of these types of responses over the more standard modes of singing and verbalizing becomes more apparent with each new study. To cite Williams:

> The research indicates that the nature of the pitch discrimination task may influence the report elicited from children. . . . Although a variety of instrumentation has been used in research with pitch (motion) identification, it is not possible to ascertain an ideal instrumentation for response mode.[49]

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[49]David B. Williams, p. 7.

CHAPTER THREE

Design of the Study

This chapter contains all of the procedures followed to complete the investigation and obtain the necessary data. These include: 1) the identification and selection of the sample, 2) the development of the response instrument and the Pitch Matching Abilities Tasks, 3) pilot studies, 4) procedures, 5) design, 6) analysis of data, and 7) testable hypotheses.

The Sample

This study addressed the identification of specific perceptual levels in first grade children who were involved with elementary general music programs in Michigan elementary schools. The first grade level was selected mainly because it was the initial grade serviced by the music specialist, in a majority of Michigan schools. (The Kindergarten level is usually involved with musical activities through the regular classroom teacher.)

The geographical area surrounding Michigan State University proved unsuitable for selection purposes for a variety of reasons. Furthermore, it was desirable to select schools from differing areas of the state, and differing

school district sizes, due to the nature of the study. This procedure was not followed, however, to introduce the independent variable of 'school'.

Two criteria were necessary for a school to be considered for selection. They were: 1) the existence of an elementary general music program in the school, and 2) a location of less than one hundred miles from the East Lansing campus. The first criterion was stipulated so that all children would have the same school music background, and the second criterion was set because of a time factor.

The research was to be carried out during May of the 1977-78 school year. This date was quite late in the school year. Consequently many schools did not want the intrusion of the researcher and opted not to participate. Therefore, the researcher contacted colleagues in elementary music teaching positions and asked if their schools might be willing to participate in the study. If the response from the music teacher was positive, a letter was sent to the school's principal requesting permission to use the school in the proposed study. (See Appendix A)

It was decided previously that four different elementary school situations would be adequate for the testing. The first four schools to indicate their willingness to participate were:

Springview Elementary School, Flushing, Mi.
Hughes Elementary School, Marshall, Mi.
Pepper School, Oak Park, Mi.
Coopersville Elementary School, Coopersville, Mi.

The schools were geographically dispersed, ranging from 45 to 90 miles from the campus. They represented both urban and rural settings, as well as different size school districts.

Upon securing each principal's permission to include the school in the sample the researcher visited each building and explained the study to the administration and teachers involved. Instrumentation was also demonstrated. At this time the selection process was outlined. Each school was to submit a list of all first grade children and their respective teachers were to indicate with a check (✓) those children who had been identified as possessing hearing difficulties. (This information came from audiometer tests administered in the fall and teachers observances during the school year.) These children were excluded from the sample population. The researcher then selected ten students, five boys and five girls, at random from the list. This procedure was followed at each school and eventually yielded forty subjects for the study.

A questionnaire was developed for the purpose of obtaining some background information concerning each subject's home musical environment. (Appendix B) This data seemed important to the study. In order to obtain the necessary information as soon as possible, the researcher obtained the telephone numbers of the children selected and attempted to collect the data by phone. Sheets were prepared in advance to record the responses. At the same time

parental permission to include the child in the study was secured.

Many of the 'selected' children's parents were not at home when the researcher telephoned and therefore the process of random re-selection and telephoning was continued until permission and home musical information was obtained for the sample (ten students per school). When a contact was made, the conversation followed this format:

> "Hello. Is this Mrs._____? My name is Louise Patrick and I'm calling from _____ Elementary School. As part of my requirements for my Ph.D. in Music Education at MSU I am conducting a study of certain musical skills with first grade children. I'd like to know if you will allow your son/daughter, _____, to participate in my study? (Pause) The study involves several musical games that your child will play with me. They will take place during the regular school day and only take about five minutes to complete. Do you have any questions? (Pause) Good. I'd like to know a little bit about _____'s home musical background. Would you mind answering a few questions?"

At this point the Home Environment questionnaire was dictated and responses were recorded on the prepared sheets. The conversation resumed:

> "Thank you very much for your time answering my questions and your permission to involve _____. I am sure he/she will enjoy the musical games. Good-bye."

A few facts concerning this process are appropriate to relate at this time. Of primary importance was the fact that all of the parents contacted by the researcher agreed to allow their children to participate, as well as to furnish the necessary home environment data. Many supplied more

information than was requested! Second, many were concerned as to the nature of the activities and if the school supported this project. Third, all of the parents thought that their children would enjoy the musical aspect of the study. Finally, several parents questioned the credibility of the phone call, the researcher and the study and immediately called the school principal to verify the situation after the conversation with the researcher was completed. The telephone communication served to provide a useful means of data collection.

Hardware and Instrumentation

One of the conditions of this study was to develop a diagnostic tool to measure auditory pitch perception abilities in young (first grade) children. It was hoped that this tool would require simple manipulation and yet be attractive to young children. A precedent for the Pitch-in-a-cans was the Montessori bell system. This invention was merely a set of differently pitched bells that were mounted on blocks of wood -- all of which were the same size. The idea was sensorial based: objects differed from each other in one and only one quality, the one which concerned the stimulation of the sense under education.[1] Like the

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[1]Maria Montessori, The Elementary Method, translated by Arthur Livingston, (Cambridge, Mass: Robert Bentley, Inc., 1971), p. 319.

Montessori bells, the Pitch-in-a-cans were designed to 'stimulate' the aural sense.

A student/audio-repairman from the university designed the Pitch-in-a-cans for the study. They were made from Campbell soup cans and were equipped with small, battery-powered, variable pitch, electronic tone generators that produced single pitches with a modified square wave.[2] These cans were tuneable by means of a small screw located in the base of the can, and allowed for well-controlled likenesses as well as differences in pitch. They were green in color (contac paper) with a black, sponge-like top. Sound was initiated by a spring-loaded switch located in the base of the can - merely lifting the can allowed it to sound. Figure 3-1 represents a diagram of one Pitch-in-a-can.

The pitch of the cans ranged from C^4 (middle C) to G^7, (three octaves and a fifth above). The higher frequencies were quite harsh however. For the purpose of the study the Pitch-in-a-cans were tuned to the pitches found in the normal singing range of a first grade child, namely, C^4 to A^4. Seven cans were designed to accomodate this range.

Several simple manipulations were desired, requiring little verbal response. The Pitch Matching Abilities Tasks

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[2]A square wave consists of a fundamental tone and of odd numbered partials, whose amplitude relations are inversely proportional to their numerical order within the series. (Ernst, 1977).

Scale drawing of one Pitch-in-a-can

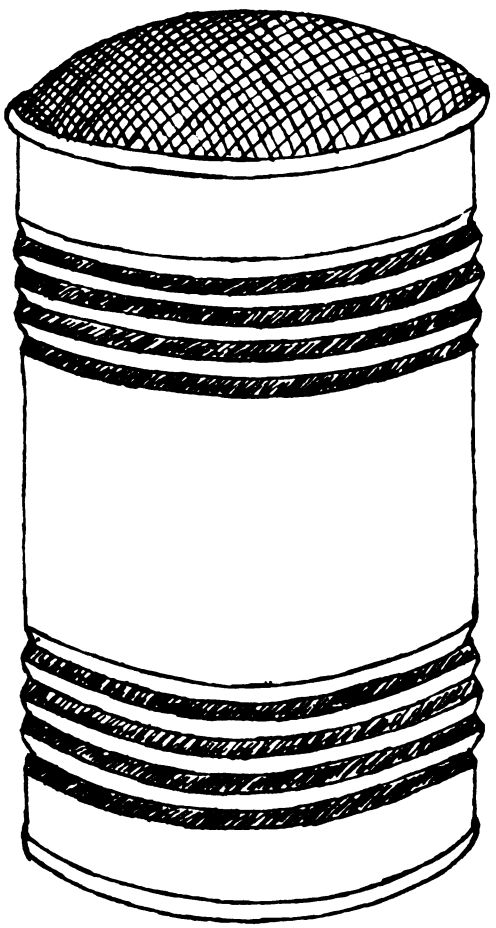

Figure 3-1

were designed to serve this purpose. These four tasks represented different guidelines for manipulation and it was believed that each task represented a different level of auditory perception skill. The first task (T_1) was reminiscent of the first Montessori exercise. That is, to allow the child to recognize identities.[3] For this purpose a series of three Pitch-in-a-cans were presented to the child. After listening to all three the child was to isolate (or remove from the series) the can that 'did not belong' or 'did not sound like the other two'. Differences between the pitched cans varied from a perfect fifth to a minor second (semi tone). This would allow for two separate analyses of the data. The ability of each child to discriminate between like and unlike tones and the degree of fineness (DL) of that perception. The six items comprising Task 1 (T_1) are notated in Figure 3-2.

The second task (T_2) represented an alteration of the first task. The child was given a series of three Pitch-in-a-cans, all of differing pitches. The researcher had one can tuned to match one in the set held by the child. Upon hearing the stimulus tone (researcher's can) the child was to listen to each of his/her own cans and select the one that matched. No limitations were put on the number of times a child could hear either the stimulus pitch or his

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[3]Montessori, p. 320.

PITCH MATCHING ABILITIES TASKS

Task 1

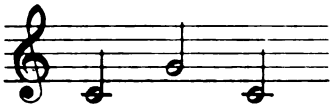
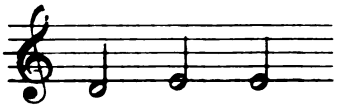
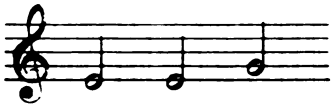
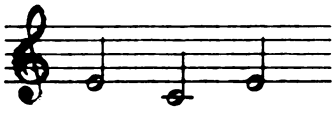
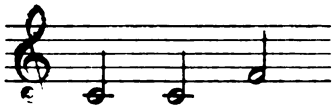
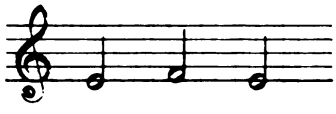
Item No.	Order of Stimuli
1	
2	
3	
4	
5	
6	

Figure 3-2

own cans. Six items were again developed and they are notated in Figure 3-3.

This second task appeared to identify the ability of the child to match individual tones. As defined in Chapter I (p. 9) pitch matching requires the differentiation between sounds and the grouping of like and unlike sounds. In selecting the can that 'matched' the stimulus tone, the child isolated likeness from difference.

The second task also sought to investigate the child's ability to match the stimulus tone with a vocal response. This procedure was followed after the six items involving the Pitch-in-a-cans were completed. The researcher merely lifted the various stimulus cans and asked the child to sing, hum, or buzz like the can. Pitches used for the purpose were C^4, E^4, G^4 and A^4.

The third task (T_3) was geared to identify the ability of a child to perceive short tonal patterns. These patterns were to be representative snatches of children's songs from music textbook series, though not recognizable by the children. Since a study by Petzold (1960) did an exhaustive study of the patterns that occur in childrens songs, the researcher selected various patterns from those identified by Petzold.[4] Several patterns were extremely

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[4]Robert G. Petzold, Development of Auditory Perception of Musical Sounds By Children in the First Six Grades, CRP No. 766 (June 30, 1960 University of Wisconsin, pp. 17-18.

PITCH MATCHING ABILITIES TASK

Task 2

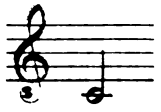
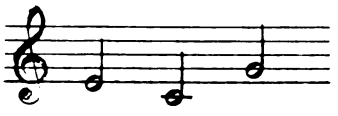
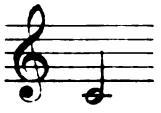
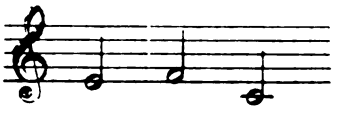
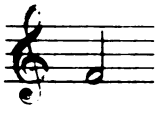
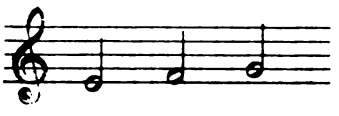
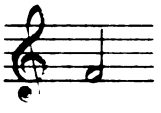
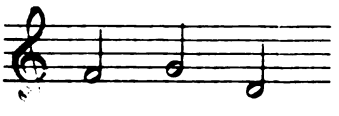
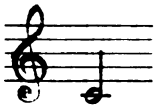
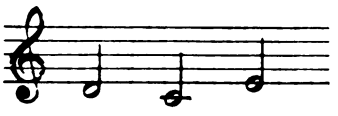
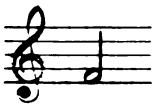
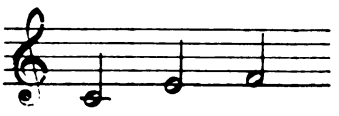
Item No.	Stimulus Tone	Order of Choices
1		
2		
3		
4		
5		
6		

Figure 3-3

'popular' (i.e., occurring frequently in songs) whereas others were somewhat obscure.

Items for Task 3 were designed to elicit two responses. The child was given a series of three Pitch-in-a-cans that were numbered from left to right as cans one, two and three. Prior to listening to his/her series of tones the child listened to a three tone pattern played by the researcher on a soprano glockenspiel. The child was then asked to pick up the cans in order (left to right) and decide if the tune in the cans sounded 'just like' the one played by the researcher. Both verbal and head shaking responses were encouraged. If the child required additional listenings to either the stimulus pattern or his own these were provided. This segment of the item sought to identify the differentiation of tonal patterns.

Once the child responded to the question of whether or not the two tunes were alike a second response was encouraged. That is, if the child decided that the can 'arrangement' was not like the tune played by the researcher, he/she was allowed to manipulate the cans until they produced a tune identical to the stimulus. When requested, the stimulus pattern was reiterated for the child. This second segment of the item required specific pitch matching abilities for several tones. The six items designated as Task 3 are notated in Figure 3-4.

The fourth, and final, task required another vocal response from the child. Each child was asked if he/she knew

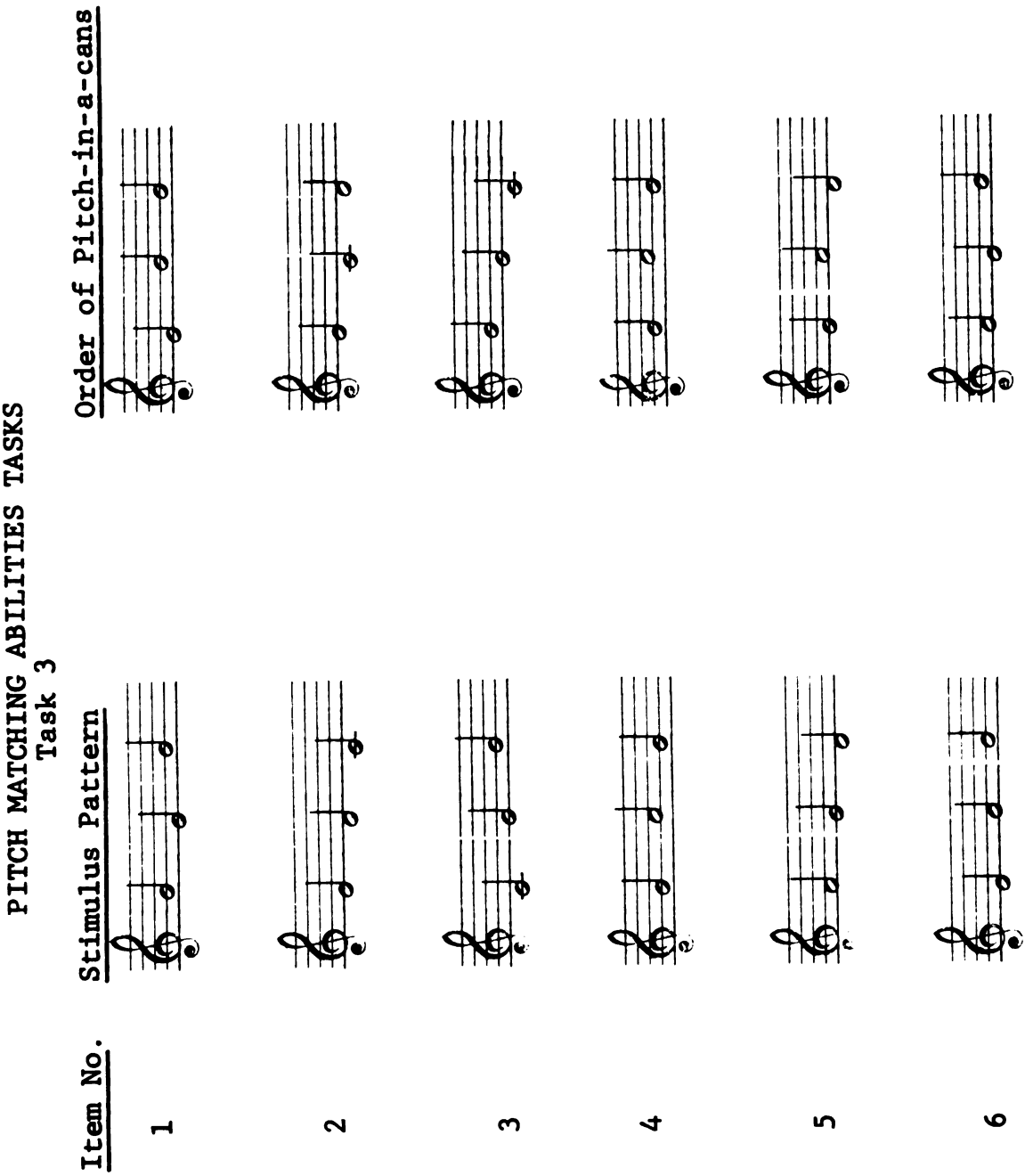

PITCH MATCHING ABILITIES TASKS
Task 3
Item No.
Stimulus Pattern
Order of Pitch-in-a-cans
1
2
3
4
5
6

Figure 3-4

the songs Twinkle, Twinkle Little Star or This Old Man. If they did, one song of their choice was sung - the researcher volunteering to start the song with the child if they so desired. The researcher then listened to see if the child could sing the song recognizably within the initial key. Upon completion of the song the researcher gave the child several Pitch-in-a-cans. These represented the initial configuration of the song performed. The child was then instructed to arrange the cans so that they 'sang' the first part of their song. As much time as was necessary was allowed for this task. Completion of the first song then prompted a final task. The child was asked if he/she knew the songs Are You Sleeping or Mary Had a Little Lamb and was again encouraged to sing one. Once the song was completed several Pitch-in-a-cans were handed to the child (appropriate to the initial configuration again) and manipulation of the cans to 'sing' this second song was endorsed. Two songs were used for this task because it was of interest to the researcher if songs that moved primarily by skips (e.g., Twinkle, Twinkle and This Old Man) were easier to sing and perceive than songs that moved primarily by steps (e.g., Are You Sleeping and Mary Had a Little Lamb). The tones representing the various configurations necessary for Task 4 are notated in Figure 3-5.

PITCH MATCHING ABILITIES TASKS

Task 4

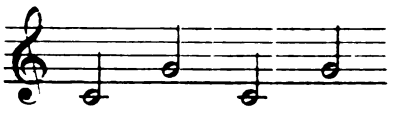
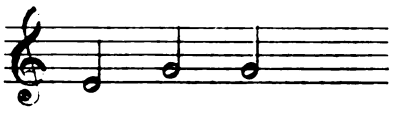
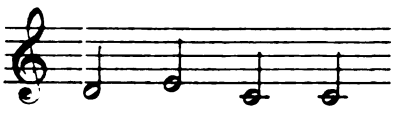
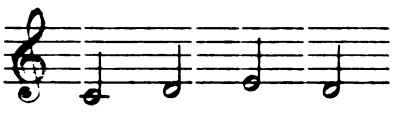
Item No.	Song	Configuration Order
1	Twinkle, Twinkle	
	This Old Man	
2	Are You Sleeping	
	Mary Had a Little Lamb	

Figure 3-5

Pilot Studies

Two pilot studies were accomplished prior to the data collection in May. The first study hoped to develop a suitable process for introducing young children to the Pitch-in-a-cans. A nearby elementary school housed a pre-school program for three and four year old children and was directed by a friend of the researcher. She was acquainted with the Pitch-in-a-cans and offered her pre-schoolers as subjects for the pilot study. Since the Pitch-in-a-cans were devised for use with young children this opportunity seemed ideal. Two consecutive morning and afternoon sessions yielded a total of forty subjects for the pilot.

After making the necessary introductions to the class as a whole the researcher took each child individually into a small room adjoining the regular classroom. The child was seated at a small table and was given a Pitch-in-a-can to 'look over'. Colors were noted and then the child was asked to verbalize as to what he/she thought the object was. Responses ranged from boxes to cups to 'I don't know'. The researcher then explained that the object was once a Campbell soup can. Many children then saw a resemblance. This 'can', however, according to the researcher, was magic and the child was instructed to pick it up. Most of the children were pleasantly surprised upon hearing the sound emitted from the can. Many asked how the can made the sound - others found the release switch on the bottom. When

asked "why was the can magic" the children responded: "it buzzed" or "it sounds like a horn". Two children actually hummed the pitch (C^4) to show what they heard.

Following this introduction a simple pitch matching exercise was tried. Each child was given two cans - pitches G^4 and C^4. The researcher instructed the child to listen to the sound of her can (C^4). Then she said "Can you find a can that sounds just like mine?" (pointing to the two cans). The child was encouraged to pick up each can, listen and pick the one that matched. The children were allowed to hear all the pitches as much as they desired.

Of the forty children tested, twenty (50%) were able to correctly select the matching can (C^4). Seventeen children picked the other can (G^4) and two said that all the cans were alike. One child did not respond.

A second task, involving the same process but containing sounds with smaller differences, was tried on a random sample of twenty-two of the forty subjects. The pitches involved in this task were C^4, C^4 and E^4. Ten of the twenty-two children successfully picked the correct can, even though the order of presentation had been altered from the first task. The same ten children had scored a correct response on the first task. The children enjoyed the Pitch-in-a-cans immensely and only one child of forty piloted refused to pick up the Pitch-in-a-can.

A second pilot study was conducted to try out the Pitch Matching Abilities Tasks. The researcher telephoned an

elementary school where she had once taught elementary general music and asked the principal for permission to visit the school and pilot the 'measures' on some first grade children. The principal agreed and one morning was set aside for this purpose.

The school had three first grade classrooms each consisting of approximately twenty-four children. Six children were randomly selected from each classroom, yielding a sample of eighteen subjects. Tasks 1 through 4 were randomly piloted on the subjects although all of the subjects were tested on Task 1. The responses to the piloted items are reported in Appendix C.

Content validity for the Pitch Matching Abilities Tasks was established by a panel of experts consisting of sev eral university music professors, a professor of music from outside the university and graduate students in Music Education at Michigan State University. Reliability was computed by a correlation across frequency of response, rather than a test-retest or split-half method. This was done because of the small number of items used, the difference between tasks measured, and the effect of familiarity with the cans and tasks due to the time factor involved. The reliability coefficient for response for the preschool children (first pilot study) was .93 and for the first grade children (second pilot study) was .96.

Procedures

Upon securing the appropriate background information for the required forty subjects, three separate testing dates were arranged with the principals of the cooperating schools. Measurements would take place during the weeks of May 1, May 8, and May 15. All visitations would occur in the morning and the schedule of schools was: Monday - Springview, Tuesday - Hughes, Wednesday - Pepper, and Friday - Coopersville.

Prior to the first visitation IBM answer sheets were prepared for each subject. The day of the first measurement the researcher introduced herself to each first grade classroom and presented a brief explanation of the project.

> "My name is Louise Patrick and I am here to play several musical games with some of you. I will take you one at a time to play these games and I will come to the school every week for the next three weeks. We will play these games in ..... (this varied from the music room to the principal's office). I am sorry that I will not be able to play these games with all of you but I do want those of you who do get selected to try your best! I have given your teacher a list of names - I will come to the room to pick you up when your turn comes."

The researcher then took the first child to the testing room and seated him/her at a small table. The child was instructed to look at the object on the table, making sure not to pick it up. The following conversation ensued:

> "What do you think that is? Can you tell me what colors you see? Yes, black and green. Have you ever had Campbell's soup for lunch? That's a green soup can - but its a magic can. Do you know

> why? (pause) Pick it up. (Sound emitted was the pitch C^4. Why is the can magic? Did you hear something? These cans (pointing to all seven) all make sounds and we are going to play my games using these cans. Are you ready?"

From this point the session was tape recorded on a Sony portable cassette recorder. The child was given instructions for Task 1 and proceeded with the six items. Responses were recorded on the answer sheet by the researcher as the child completed each item. A complete script of the procedure followed for each task is provided in Appendix D.

The above process was reiterated for all ten subjects at each of the four schools. Prior to leaving the researcher secured the time for the next visit the following week.

The second and third visits were carried out in a similar manner, however, the introductory remarks concerning the Pitch-in-a-cans were eliminated. The child was merely reminded of last week's game and then introduced to the new game. The children were extremely eager to play with the cans. The second visit measured Task 2, both with the Pitch-in-a-cans and the vocal response. The first item of Task 4 (song with skips) was also measured. Since a consistency of measurement and execution was established from recording the first visitation, the second and third measurements were not taped unless problems occurred.

The scoring procedure for the vocal response was a simple "Yes" or "No". "Yes" indicated that the child could match the given stimulus pitches, and "No" indicated that

he/she tried and could not. A "NR" was recorded for no response. The song ability was judged as to the recognizability (within the child's own range) of the tune when sung by the child. A perfect response was not necessary to achieve a "Yes" response. Lyrics were not taken into account.

The third visit to the school measured Task 3 and the second song from Task 4 (songs with steps). The additional equipment necessary for this measurement (soprano glockenspiel) was supplied by the researcher.

After the last child had been tested in each school the researcher took the Pitch-in-a-cans back to the classrooms and allowed the other children, who had not participated in the study, to play with the cans. Classroom teachers were thanked regarding their flexibility and notes were sent home with the participants, thanking parents for their support of the project. A letter of thanks was also sent to each principal. These documents are supplied in Appendix A.

Design

A 2 x 2 x 4 split-plot repeated measures design (Kirk, 1968) was selected as the research design for the study. The independent variables were Sex and Age. Each variable had two levels - Sex (male and female) and Age (LO - 77 to 83 months and HI - 84 to 99 months). The dependent variable was auditory perception (pitch-matching) performance

ability, as measured by the task scores on the Pitch Matching Abilities Tasks. Two other variables, Singing Ability and Home Musical Environment were included for correlational purposes.

Treatment of the Data

The data were transferred from the IBM answer sheets to computer cards by the researcher. This included information regarding sex, age, singing ability and home musical environment. The data analysis was done by a CDC 6500 Computer System housed in the Computer Center at Michigan State University. An SPSS ANOVA program was used to examine the data. Other desired statistics were also computed by this system.

Testable Hypotheses

According to experimental design procedures, the hypotheses applicable to the study are stated in their null form.

H_{o_1}: There will be no difference in the performance ability of first grade children on four auditory perception tasks according to sex.

H_{o_2}: There will be no difference in the performance ability of first grade children on four auditory perception tasks according to chronological age.

H_{o_3}: There will be no difference in the performance ability of first grade children on four auditory perception tasks according to home musical environment.

H_{o_5}: No relationship exists between a first grade child's ability to sing a familiar song and to perceive it through the Pitch-in-a-cans.

H_{0_4}: There will be no difference in the performance ability of first grade children on pitch matching tasks as measured by a vocal response.

H_{0_6}: No relationship exists between a first grade child's auditory perception performance ability when measured by a vocal response and the Pitch-in-a-cans.

H_{0_7}: There will be no differ ence in the performance ability of first grade children on four auditory perception tasks as measured through the use of the Pitch-in-a-cans.

H_{0_8}: There will be no difference between tasks as measured by the Pitch Matching Abilities Tasks.

H_{0_9}: There will be no difference in the performance ability of first grade children on auditory perception tasks measuring individual tones and tonal patterns.

CHAPTER FOUR

ANALYSIS OF THE DATA

The data for this study were processed and analyzed by the computer system located at Michigan State University. An SPSS (Statistical Package for the Social Sciences) program was utilized to determine the means for the four types of task abilities for each group of subjects. Subjects were grouped by sex, age, home musical environment, and singing ability. These were coded into a special format and run through the ANOVA program which examined main effects by analysis of variance techniques.

Results

The presentation of data will follow the order of the tests of the individual null hypotheses. Null hypotheses 1 thru 4 examined auditory perception ability with respect to sex. Table 4-1 presents the descriptive statistics for the four types of task abilities (T_1, T_2, T_3, T_4) according to sex.

One concern of the study was the possible difference in perceptual ability between male and female subjects. The results of the ANOVA tests on this main effect for Task 1 (Identities) show that $F = .639$ was non-significant

Table 4-1

Task Means by Sex

	Task 1		Task 2		Task 3		Task 4	
	Mean	s	Mean	s	Mean	s	Mean	s
Males	4.45	1.52	4.50	1.21	5.05	8.05	0.45	0.576
Females	4.15	1.29	3.90	1.88	6.35	13.92	0.70	0.642

H_{0_1}: There will be no difference in a first grade child's performance ability on auditory perception Task 1 according to sex.

at the .05 level. (Table 4-2) Null hypothesis 1 failed to be rejected.

Table 4-2

ANOVA for Sex Effect on Task 1

Source of Variation	Sum of Squares	df	Mean Square	F	P
Sex	.900	1	.900	.639	.429
within	53.500	38	1.408		
Total	54.400	39	1.395		

H_{0_2}: There will be no difference in a first grade child's performance ability on auditory perception Task 2 according to sex.

The results of the ANOVA tests on this main effect for Task 2 (Individual Pitch Matching) show that F = 1.983 was non-significant at the .05 level. In order to allow for the effect of the previous week's experience (Task 1), Task 1 was added to the analysis as a covariate with Task 2. (Table 4-3)

Table 4-3

ANOVA for Sex Effect on Task 2

Source of Variation	Sum of Squares	df	Mean Square	F	P
Covariates Task 1	1.360	1	1.360	.868	.357
Sex	3.105	1	3.105	1.983	.167
within	57.936	37	1.566		
Total	62.400	39	1.600		

H_{0_3}: There will be no difference in a first grade child's performance ability on auditory perception Task 3 according to sex.

The results for the ANOVA tests on this main effect for Task 3 (Tonal Pattern Matching) show that F = 1.743 was non-significant at the .05 level. Null hypothesis 3 failed to be rejected. Tasks 1 and 2 were added to the analysis as covariates with Task 3. (Table 4-4)

The results of the ANOVA tests on this main effect for Task 4 (Song Matching) show that F = .662 was non-significant at the .05 level. Null hypothesis 4 failed to be

Table 4-4

ANOVA for Sex Effect on Task 3

Source of Variation	Sum of Squares	df	Mean Square	F	P
Covariates	7.594	2	3.797	.336	.717
Task 1	7.485	1	7.485	.662	.421
Task 2	.532	1	.532	.047	.830
Sex	19.713	1	19.713	1.743	.195
within	27.307	36	9.102	.805	.499
Total	434.400	39	11.138		

H_{0_4}: There will be no difference in a first grade child's performance ability on auditory perception Task 4 according to sex.

rejected. Tasks 1 thru 3 were added to the analysis as covariates with Task 4. The results of the ANOVA tests on the covariate of Task 3 with Task 4 show that F = 4.672 was significant at the .05 level. (Table 4-5)

Null hypotheses 5 thru 8 examined auditory perception ability with respect to chronological age. The range, in age, of the subjects was 77 to 99 months. The median age was 84 months. Therefore two groups were designated for age: LO - 77 to 83 months and HI - 84 to 99 months. Table 4-6 presents the descriptive statistics for the four types of task abilities according to age (LO,HI).

Table 4-5

ANOVA for Sex Effect on Task 4

Source of Variation	Sum of Squares	df	Mean Square	F	P
Covariates	3.033	3	1.011	1.738	.177
Task 1	.020	1	.020	.034	.854
Task 2	.185	1	.185	.318	.576
Task 3	2.717	1	2.717	4.672*	.038
Sex	.385	1	.385	.662	.421
within	20.357	35	.582		
Total	23.775	39	.610		

*$p < .05$

Table 4-6

Task Means by Age

	Task 1		Task 2		Task 3		Task 4	
	Mean	s	Mean	s	Mean	s	Mean	s
LO	4.24	1.19	3.95	1.84	6.28	14.91	.714	.614
HI	4.36	1.69	4.47	1.26	5.05	6.72	.421	.591

H_{0_5}: There will be no difference in a first grade child's performance ability on auditory perception Task 1 according to age.

A second concern of the study was the effect of chronological age on auditory perceptual ability. The results of the ANOVA tests on this main effect for Task 1 (Identities) show that F = .119 was non-significant at the .05 level. (Table 4-7) Null hypothesis 5 failed to be rejected.

Table 4-7

ANOVA for Age Effect on Task 1

Source of Variation	Sum of Squares	df	Mean Square	F	P
Age	.169	1	.169	.119	.732
within	54.231	38	1.427		
Total	54.400	39			

H_{0_6}: There will be no difference in a first grade child's performance ability on auditory perception Task 2 according to age.

The results of the ANOVA tests on this main effect for Task 2 (Individual Pitch Matching) show that F = 1.586 was non-significant at the .05 level. To allow for the effect of previous exposure Task 1 was added to the analysis as a covariate with Task 2. Null hypothesis 6 failed to be rejected. (Table 4-8)

The results of the ANOVA tests on this main effect for Task 3 (Tonal Pattern Matching) show that F = 1.39 was

Table 4-8

ANOVA for Age Effect on Task 2

Source of Variation	Sum of Squares	df	Mean Square	F	P
Covariate					
Task 1	1.360	1	1.360	.859	.360
Age	2.509	1	2.509	1.586	.216
within	58.532	37	1.582		
Total	62.400	39	1.600		

H_{0_7}: There will be no difference in a first grade child's performance ability on auditory perception Task 3 according to age.

non-significant at the .05 level. Tasks 1 and 2 were included in the analysis as covariates. Null hypothesis 7 failed to be rejected. (Table 4-9)

The results of the ANOVA tests on this main effect for Task 4 (Song Matching) show that F = .961 was non-significant at the .05 level. Null hypothesis 8 failed to be rejected. Tasks 1, 2 and 3 were added to the analysis as covariates and Task 3 was shown to be a significant co-variate at the .05 level. (Table 4-10)

A third variable of interest to the analysis was the effect of a musical home environment on auditory perception ability. On the basis of data obtained from a questionnaire

Table 4-9

ANOVA for Age Effect on Task 3

Source of Variation	Sum of Squares	df	Mean Square	F	P
Covariates	7.594	2	3.797	.333	.719
Task 1	7.485	1	7.485	.656	.423
Task 2	.532	1	.532	.047	.830
Age	15.872	1	15.872	1.390	.246
within	410.934	36	11.415		
Total	434.400	39	11.138		

H_{0_8}: There will be no difference in a first grade child's performance ability on auditory perception Task 4 according to age.

Table 4-10

ANOVA for Age Effect on Task 4

Source of Variation	Sum of Squares	df	Mean Square	F	P
Covariates	3.033	3	1.011	1.753	.174
Task 1	.020	1	.020	.035	.854
Task 2	.185	1	.185	.321	.575
Task 3	2.717	1	2.717	4.711*	.037
Age	.554	1	.554	.961	.334
within	20.188	35	.577		
Total	23.775	39	.610		

*$p < .05$

related to home musical experiences subjects were categorized as possessing either a musical home environment or a non-musical home environment. Table 4-11 presents the descriptive statistics for the four perception tasks according to home environment (Musical, Non-musical).

Table 4-11

Task Means by Home Environment

	Task 1		Task 2		Task 3		Task 4	
	Mean	s	Mean	s	Mean	s	Mean	s
Musical	4.263	1.87	4.474	1.15	5.316	12.874	.474	.596
Non-musical	4.333	1.03	3.95	1.95	6.048	9.948	.667	.663

Null hypotheses 9 thru 12 relate to the effects of home environment on auditory perception ability.

H_{0_9}: There will be no difference in a first grade child's performance ability on auditory perception Task 1 according to home environment.

The results of the ANOVA tests on this main effect for Task 1 show that F = .034 was non-significant at the .05 level. (Table 4-12) Null hypothesis 9 failed to be rejected.

The results of the ANOVA tests on this main effect for Task 2 show that F = 1.799 was non-significant at the .05 level. Null hypothesis 10 failed to be rejected. Task 1 was added as a covariate in the analysis. (Table 4-13)

Table 4-12

ANOVA for Home Environment Effect on Task 1

Source of Variation	Sum of Squares	df	Mean Square	F	P
Home Environment	.049	1	.049	.034	.854
within	54.351	38	1.430		
Total	54.400	39	1.395		

$H_{0_{10}}$: There will be no difference in a first grade child's performance ability on auditory perception Task 2 according to home environment.

Table 4-13

ANOVA for Home Environment Effect on Task 2

Source of Variation	Sum of Squares	df	Mean Square	F	P
Covariate					
Task 1	1.360	1	1.360	.864	.359
Home Environment	2.830	1	2.830	1.799	.188
within	58.211	37	1.573		
Total	62.400	39	1.600		

$H_{0_{11}}$: There will be no difference in a first grade child's performance ability on auditory perception Task 3 according to home environment.

The results of the ANOVA tests on this main effect for Task 3 show that F = .385 was non-significant at the .05 level. Null hypothesis 11 failed to be rejected. (Table 4-14) Tasks 1 and 2 were included as covariates in the analysis.

Table 4-14

ANOVA for Home Environment Effect on Task 3

Source of Variation	Sum of Squares	df	Mean Square	F	P
Covariates	7.594	2	3.797	.324	.726
Task 1	7.485	1	7.485	.638	.430
Task 2	.532	1	.532	.045	.833
Home Environment	4.517	1	4.517	.385	.539
within	422.289	36	11.730		
Total	434.400	39	11.138		

$H_{0_{12}}$: There will be no difference in a first grade child's performance ability on auditory perception Task 4 according to home environment.

The results of the ANOVA tests on this main effect for Task 4 show that F = .475 was non-significant at the .05 level. Null hypothesis 12 failed to be rejected. (Table 4-15) Tasks 1,2, and 3 were included as covariates in the analysis. Results show that for Task 3, F = 4.647 was significant at the .05 level.

Table 4-15

ANOVA for Home Environment Effect on Task 4

Source of Variation	Sum of Squares	df	Mean Square	F	P
Covariates	3.033	3	1.011	1.729	.179
Task 1	.020	1	.020	.034	.855
Task 2	.185	1	.185	.317	.577
Task 3	2.717	1	2.717	4.647*	.038
Home Environment	.278	1	.278	.475	.495
within	20.465	35	.585		
Total	23.775	39			

*p <.05

A young child's ability to sing on pitch has been thought to have an effect on auditory perception skill. Two different measures of singing ability were identified for this purpose: 1) the ability to match individual tones (pitches) and 2) the ability to sing a song within a certain tonal scheme. The descriptive statistics for these two abilities across the four perceptual tasks measured are presented in Table 4-16.

Null hypotheses 13 thru 20 relate to the effects of singing ability on auditory perception skill.

$H_{0_{13}}$: There will be no difference in a first grade child's performance ability on auditory perc eption Task 1 according to his/her ability to match individual pitches (Singing Ability 1).

Table 4-16

Task Means by Singing Abilities

Ability	Task 1		Task 2		Task 3		Task 4	
	Mean	s	Mean	s	Mean	s	Mean	s
Able to match individual tones	4.389	1.546	4.0	1.765	6.778	13.948	.944	.761
Not able to match individual tones	4.227	1.481	4.364	1.481	4.818	7.584	.273	.303
Able to sing song in tune	4.40	1.25	4.04	1.707	6.40	10.417	.680	.643
Not able to sing song in tune	4.133	1.695	4.467	1.410	4.533	10.038	.400	.543

The results of the ANOVA tests on this main effect for Task 1 show that F = .368 was non-significant at the .05 level. Null hypothesis 13 failed to be rejected. (Table 4-17)

Table 4-17

ANOVA for Singing Ability 1 Effect on Task 1

Source of Variation	Sum of Squares	df	Mean Square	F	P
Singing Ability 1	.541	1	.541	.368	.548
within	52.828	36	1.467		
Total	53.368	37			

$H_{0_{14}}$: There will be no difference in a first grade child's performance ability on auditory perception Task 2 according to his/her ability to match individual pitches (Singing Ability 1).

The results of the ANOVA tests for this main effect on Task 2 show that F = 1.137 was non-significant at the .05 level. Null hypothesis 14 failed to be rejected. Task 1 was added to the analysis as a covariate. (Table 4-18)

Table 4-18

ANOVA for Singing Ability 1 Effect on Task 2

Source of Variation	Sum of Squares	df	Mean Square	F	P
Covariate					
Task 1	1.482	1	1.482	.911	.347
Singing Ability 1	1.851	1	1.851	1.137	.294
within	56.982	35	1.628		
Total	60.316	37	1.630		

$H_{0_{15}}$: There will be no difference in a first grade child's performance ability on auditory perception Task 3 according to his/her ability to match individual pitches (Singing Ability 1).

The results of the ANOVA tests for this main effect on Task 3 show that F = 2.575 was non-significant at the .05 level. Null hypothesis 15 failed to be rejected. Tasks 1 and 2 were added to the analysis as covariates. (Table 4-19)

Table 4-19

ANOVA for Singing Ability 1/Effect on Task 3

Source of Variation	Sum of Squares	df	Mean Square	F	P
Covariates	9.989	2	4.994	.437	.650
Task 1	9.807	1	9.807	.857	.361
Task 2	.833	1	.833	.073	.789
Singing Ability 1	29.455	1	29.455	2.575	.118
within	388.872	34	11.437		
Total	428.316	37	11.576		

$H_{0_{16}}$: There will be no difference in a first grade child's performance ability on auditory perception task 4 according to his/her ability to match individual pitches (Singing Ability 1).

The results of the ANOVA tests for this main effect on Task 4 show that F = 5.330 was significant at the .05 level. Null hypothesis 16 was rejected. Tasks 1,2, and 3 were added to the analysis as covariates and Task 3 was a significant covariate at the .05 level. (Table 4-20)

The results of the ANOVA tests for this main effect on Task 1 show that F = 1.783 was non-significant at the .05 level. Null hypothesis 17 failed to be rejected. (Table 4-21)

Table 4-20

ANOVA for Singing Ability 1 Effect on Task 4

Sources of Variation	Sum of Squares	df	Mean Square	F	P
Covariates	2.771	3	.924	1.743	.177
Task 1	.059	1	.059	.112	.740
Task 2	.155	1	.155	.293	.592
Task 3	2.373	1	2.373	4.478*	.042
Singing Ability 1	2.842	1	2.842	5.330*	.027
within	17.484	33	.530		
Total	23.079	37	.624		

*p <.05

$H_{0_{17}}$: There will be no difference in a first grade child's performance ability on auditory perception task 1 according to his/her ability to sing a song in tune (Singing Ability 2).

Table 4-21

ANOVA for Singing Ability 2 Effect on Task 1

Source of Variation	Sum of Squares	df	Mean Square	F	P
Singing Ability 2	2.571	1	2.571	1.783	.191
within	47.600	33	1.442		
Total	50.171	34	1.476		

$H_{0_{18}}$: There will be no difference in a first grade child's performance ability on auditory perception Task 2 according to his/her ability to sing a song in tune (Singing Ability 2).

The results of the ANOVA tests for this main effect on Task 2 show that F = 2.367 was non-significant at the .05 level. Null hypothesis 18 failed to be rejected. Task 1 was added to the analysis as a covariate. (Table 4-22)

Table 4-22

ANOVA for Singing Ability 2 Effect on Task 2

Source of Variation	Sum of Squares	df	Mean Square	F	P
Covariate					
Task 1	2.590	1	2.590	1.679	.204
Singing Ability 2	3.651	1	3.651	2.367	.134
within	49.359	32	1.542		
Total	55.600	34	1.635		

$H_{0_{19}}$: There will be no difference in a first grade child's performance ability on auditory perception Task 3 according to his/her ability to sing a song in tune (Singing Ability 2).

The results of the ANOVA tests for this main effect on Task 3 show that F = .747 was non-significant at the .05 level. Null hypothesis 19 failed to be rejected. Tasks 1 and 2 were added to the analysis as covariates. (Table 4-23)

Table 4-23

ANOVA for Singing Ability 2 Effect on Task 3

Source of Variation	Sum of Squares	df	Mean Square	F	P
Covariates	15.840	2	7.920	.702	.503
Task 1	15.678	1	15.678	1.390	.247
Task 2	.213	1	.213	.019	.892
Singing Ability 2	8.428	1	8.428	.747	.394
within	349.732	31	11.282		
Total	374.000	34	11.000		

$H_{0_{20}}$: There will be no difference in a first grade child's performance ability on auditory perception task 4 according to his/her ability to sing a song in tune (Singing Ability 2).

The results of the ANOVA tests for this main effect on Task 4 show that F = .005 was non-significant at the .05 level. Null hypothesis 20 failed to be rejected. Tasks 1, 2 and 3 were added to the analysis as covariates. (Table 4-24).

The purpose of the study was to develop a measure that identified different levels of auditory perception ability. The Pitch Matching Abilities Tasks were devised for this purpose. This 'measure' consisted of four tasks: Task 1 - Identities Matching, Task 2 - Individual Pitch Matching,

Table 4-24

ANOVA for Singing Ability 2 Effect on Task 4

Source of Variation	Sum of Squares	df	Mean Square	F	P
Covariates	2.366	3	.789	1.212	.322
Task 1	.088	1	.088	.135	.716
Task 2	.124	1	.124	.190	.666
Task 3	1.816	1	1.816	2.791	.105
Singing Ability 2	.003	1	.003	.005	.947
within	19.517	30	.651		
Total	21.886	34	.644		

Task 3 - Tonal Pattern Matching, and Task 4 - Song Matching.

In order to determine if any relationship existed between the auditory perception abilities measured and the type of tasks used, a Pearson-Product Moment Correlation was computed across tasks. This matrix appears in Figure 4-1.

Correlation Matrix Across Tasks

	Task 1	Task 2	Task 3
Task 1			
Task 2	.14761		
Task 3	.12750	-.01579	
Task 4	.08620	.08827	.34342

Figure 4-1

All of the correlation coefficients, except Task 3 vs. Task 4 (.34342), indicate almost no correlation across tasks. This would infer that there is a difference in the task utilized to measure the perceptual abilities of the children. The correlation coefficient between Task 3 and Task 4, though not being a significantly strong correlation, helps to explain the significance of Task 3 as a covariate in the ANOVA tests for Null Hypotheses 4, 8, 12, and 16.

Null hypothesis 21 addressed the significance of the different tasks used across the forty first grade subjects.

$H_{0_{21}}$: There will be no difference in a first grade child's auditory perception performance ability according to task.

The results of the ANOVA tests for this main effect on Auditory Perception Performance Ability show that F = 56.384 was significant beyond the .01 level (p <.0001). Null hypothesis 21, therefore, was rejected. (Table 4-25)

Table 4-25

ANOVA for Task Effect on Auditory Performance by Subjects

Source of Variation	Sum of Squares	df	Mean Square	F	P
Between Subjects	177.24375	39	4.54471		
Within Subjects	972.75000	120	8.10625		
Between Tasks	575.01875	3	191.67292	56.384**	.0001
error	397.73125	117	3.39941		
Total	1149.99375	159	7.23267		

**p <.0001

Since there was a significant difference according to task of the auditory perception ability measured, other investigations could not be accomplished. The data for the individual items included in each Task are furnished in Table 4-26 and graphs comparing all items in each task are illustrated in Figures 4-2 thru 4-5.

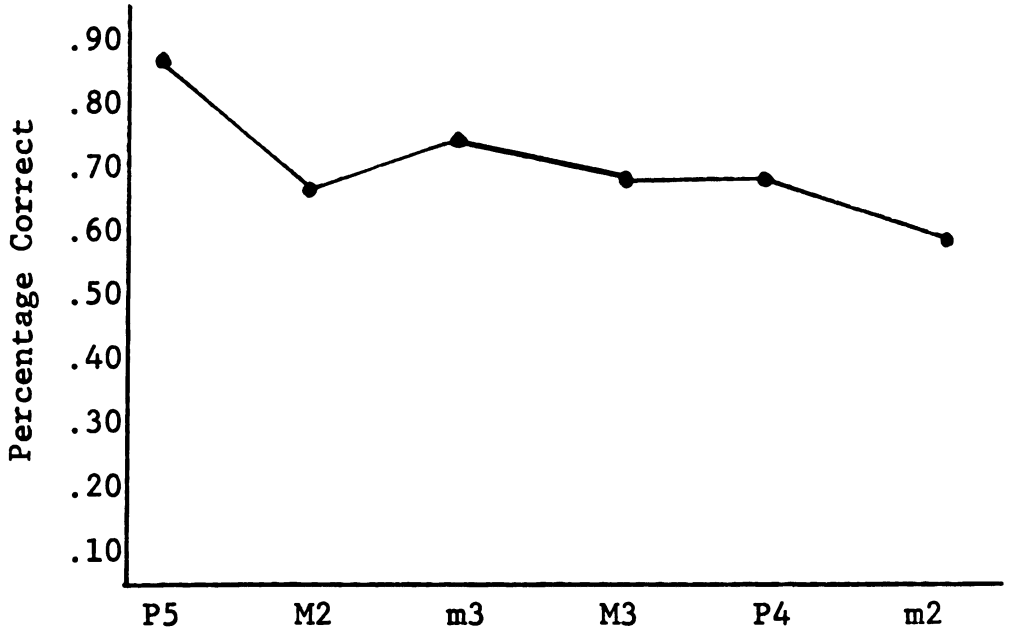
Table 4-26

Descriptive Statistics for Items

Item No.	Task	Mean	sd	Item No.	Task	Mean	sd
1	1	.875	.335	16	3	.333	.478
2		.675	.474	17		.694	.467
3		.750	.439	18		.222	.422
4		.700	.464	19		.833	.381
5		.700	.464	20		.778	.422
6		.600	.496	21		.667	.478
7	2	.900	.304	22		.222	.422
8		.700	.464	23		.611	.494
9		.550	.504	24		.278	.454
10		.750	.439	25	4	.333	.479
11		.750	.439	26		.323	.475
12		.550	.504	Task 1 Total		4.300	1.181
13	3	.611	.494	Task 2 Total		4.200	1.265
14		.444	.504	Task 3 Total		5.700	3.337
15		.639	.487	Task 4 Total		.575	.780

Figure 4-2 illustrates the percentage of correct responses for Items 1-6, identified as intervals, as measured by Task 1.

Frequency of Correct Responses for Items 1 to 6



Items 1-6 as interval discriminations

Figure 4-2

Frequency of Correct Responses for Items 7 to 12

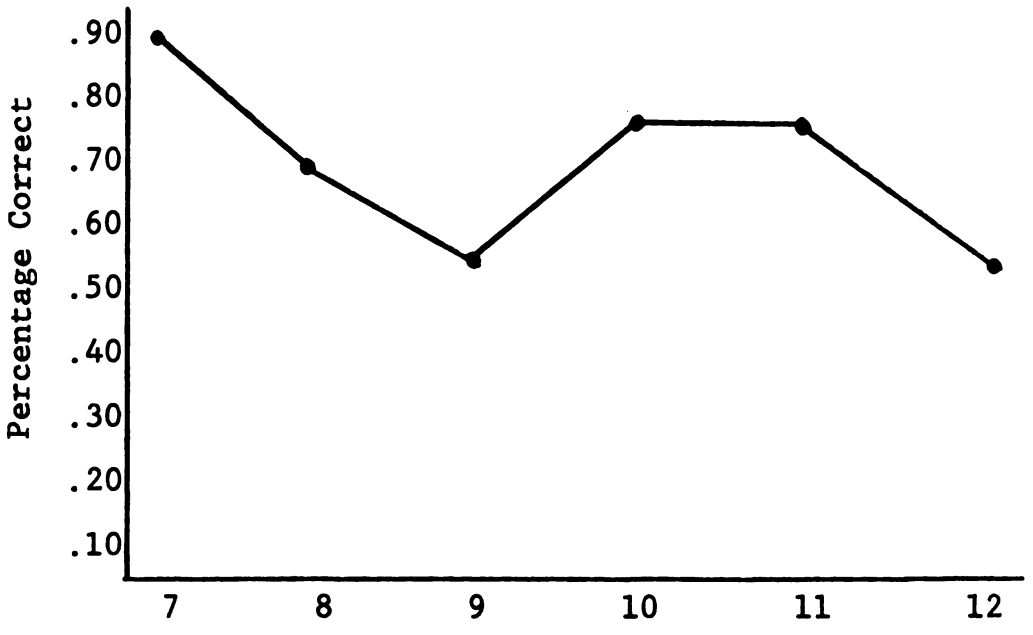


Figure 4-3

It is important to note that perception of the smallest interval included (m2) was successfully discriminated by 60% of the subjects. (Item 6) This corresponds with previous research.

Figure 4-3 illustrates the frequency percentages of correct responses for Items 7-12. These items required simple manipulation of single tones to locate a sound identical to a stimulus tone. Items 9 and 11 required discrimination of semi-tones between possible choices whereas items 7, 8, 10 and 11 all represented choices with skips between pitches. This might affect the correctness of response, especially with respect to the information supplied from Task 1 - item 6.

Figures 4-4 and 4-5 are representative of the dichotomous nature of Task 3. That is, one response (illustrated in Figure 4-4) required a simple discrimination among two tonal patterns - was pattern two 'like' pattern one? The mean response across Items 13, 15, 17, 19, and 21 was .611. This illustrated over sixty percent achievement on the discrimination portion. Figure 4-5, however, shows the mean response across Items 14, 16, 18, 20, and 22, or a composite mean of .36. These items measured the pitch matching abilities of the subjects to correctly manipulate the 'cans' to match the stimulus pattern. With the exception of item 20 (a pattern that required no changes in manipulation) all of the means were less than .50. This would tend to indicate

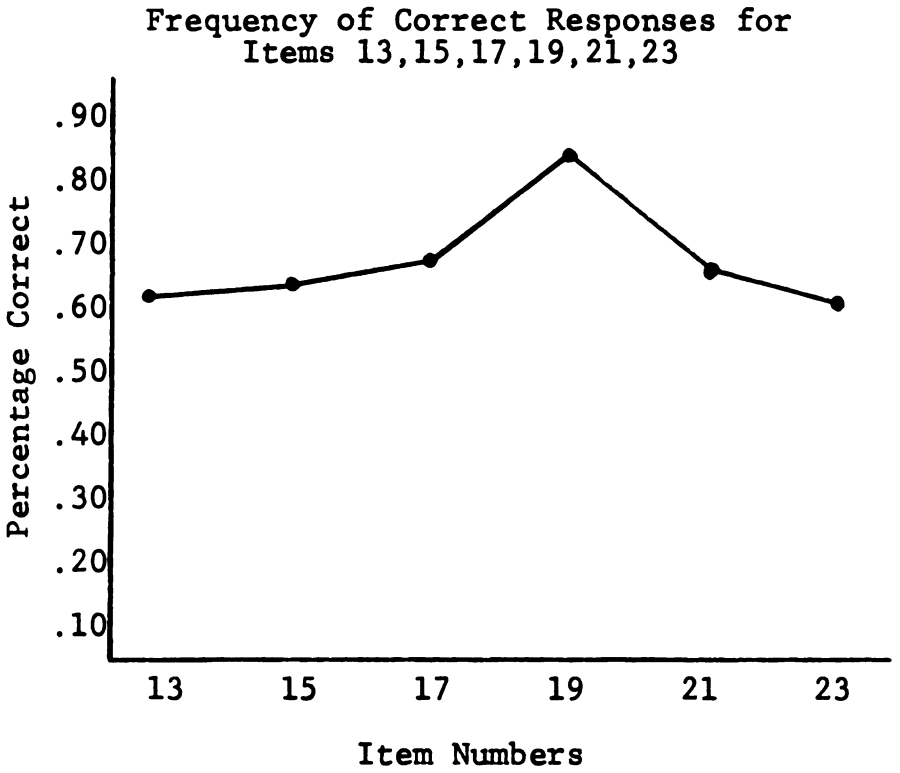


Figure 4-4

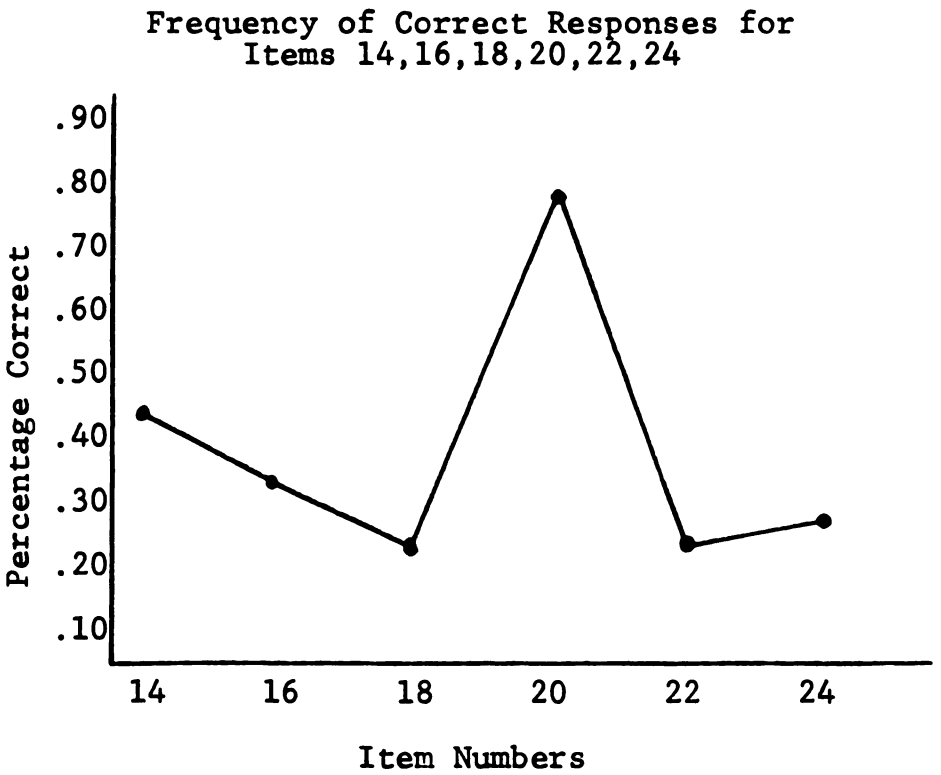


Figure 4-5

that the matching response was a more difficult task than the discriminatory task that preceded it.

Table 4-27

Summary of Hypotheses Tests

Hypothesis No.	Description	Fail to reject	Reject
1	Sex on Task 1 (Identities)	x	
2	Sex on Task 2 (Ind. pitch match)	x	
3	Sex on Task 3 (Tonal pattern match)	x	
4	Sex on Task 4 (Song Match)	x	
5	Age on Task 1	x	
6	Age on Task 2	x	
7	Age on Task 3	x	
8	Age on Task 4	x	
9	Home Environment on Task 1	x	
10	Home Environment on Task 2	x	
11	Home Environment on Task 3	x	
12	Home Environment on Task 4	x	
13	Singing Ability 1 (Match pitch) on Task 1	x	
14	Singing Ability 1 on Task 2	x	
15	Singing ability 1 on Task 3	x	
16	Singing Ability 1 on Task 4		x
17	Singing Ability 2 (Sing Song) on Task 1	x	
18	Singing Ability 2 on Task 2	x	
19	Singing Ability 2 on Task 3	x	
20	Singing Ability 2 on Task 4	x	
21	Tasks on Subjects		x

The items that identified the ability of a child to manipulate a series of cans to match a phrase of a familiar song (Task 4 - Items 25,26) had means similar to the composite mean across the manipulative task in Task 3. That is, the means for song phrase manipulation were .333 and .323 respectively.

Summary

As a result of the analysis of data, null hypotheses 16 and 21 were rejected. The main effects of Singing Ability 1 on Task 4 and Tasks were found to be significant at the .05 level. The remaining null hypotheses failed to be rejected.

Due to the difference across tasks some of the questions raised in Chapter I (e.g. H_q) could not be answered. Table 4-27 summarizes the twenty-one hypotheses and indicates rejection of the null hypotheses when appropriate.

CHAPTER FIVE

SUMMARY AND CONCLUSIONS

The primary purpose of this study was to investigate selected pitch matching abilities of first grade children. Factors considered to be important to the development of these perceptual skills were sex, chronological age, home musical environment and singing ability.

Much research has been conducted in the fields of auditory (pitch) perception and discrimination. A longitudinal study by Petzold[1] represents the most extensive research devoted to the identification of auditory perception levels in school age children. Similarly, a report by Andrews and Diehl[2] sought to qualify musical conceptualization processes in young children. Studies by Bentley[3], Zwissler[4],

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[1]Robert G. Petzold, Auditory Perception of Musical Sounds By Children in the First Six Grades, CRP 766, June 30, 1967, University of Wisconsin.

[2]Frances Andrews and Ned C. Diehl, Developing a Technique for Identifying Elementary School Children's Musical Concepts, Final Report BR 5-0233, September, 1967, Pennsylvania State University.

[3]Arnold Bentley, Musical Ability in Children and Its Measurement, (London: Harrap and Co., Ltd., 1966).

[4]Ruth N. Zwissler, "An Investigation of the Pitch Discrimination Skills of First Grade Children Identified as Accurate Singers and Those Identified as Inaccurate Singers", Unpublished Doctoral Dissertation, University of California, 1971.

Clegg[5], Duell and Anderson[6] and Williams[7] have investigated various aspects of pitch discrimination abilities in young children.

The use of non-verbal measures for identifying perceptual abilities in young children has also been researched. Jeffrey[8] noted that when using adults as subjects a response mode rarely caused problems. However, when using children, the response required could make a difference between learning and not learning. Studies by Hair[9] and Van Zee[10] reported significant differences on perceptual tasks when using non-verbal response indicators with young children.

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[5]Beth W. Clegg, "A Comparative Study of Primary Grade Children's Ability to Match Tones", Unpublished Master's Thesis, Brigham Young University, 1966.

[6]Orpha K. Duell and Richard C. Anderson, "Pitch Discrimination Among Primary School Children", Journal of Educational Psychology, Vol. 58, No. 6, 1967, pp. 315-318.

[7]David B. Williams, "Children's Identification of Melodic Pitch Motion: Effects of Initial Proficiency, Interval Size and Direction, and Durational Variation". Technical Note, Southwest Regional Laboratory, Los Alamito, California, 1975.

[8]Wendell E. Jeffrey, "Variables in Early Discrimination Learning: II. Mode of Response and Stimulus Difference in the Discrimination of Tonal Frequencies", Child Development, Vol. 29, no. 4, December, 1958, pp. 531-537.

[9]Harriet I. Hair, "Discrimination of Tonal Direction on Verbal and NonVerbal Tasks by First Grade Children", Journal of Research in Music Education, Vol. 25, no.3, Fall, 1977, pp. 197-207.

[10]Norma Van Zee, "Responses of Kindergarten Children to Musical Stimuli and Terminology", Journal of Research in Music Education, Vol. 24, no. 1, Spring, 1976, pp. 14-21.

For the present study a three factor split-plot repeated measures design (Kirk, 1968) was selected for the study. Independent variables were sex, chronological age, and task. The dependent variable was correctness of response on selected pitch matching items (auditory perception performance ability).

The data gather instrument was a series of four pitch matching tasks consisting of six, six, six, and two items, respectively. The Pitch Matching Abilities Tasks were designed by the researcher for the express use of this study. The first two tasks involved the manipulation and identification of individual tones (pitches) and the remaining two tasks required manipulations with groups of tones (patterns). All items were randomized within tasks.

A special instrument was developed for use in the study. The Pitch-in-a-cans provided for simple manipulation of tone (pitch) by the subjects. There was little need for a verbal response.

The forty first-grade children who acted as subjects for the study were randomly selected from four elementary schools in Michigan. Twenty boys and twenty girls comprised the sample. Thirty-six of the forty subjects were present during all measurement visitations. Four subjects were absent during the final week of the study.

Findings

Twenty-one hypotheses were examined in their null form. MANOVA, an analysis of variance computer program which handles multiple analyses with repeated measures designs was to have been used for the study. Complications due to blocking caused the program to malfunction. Therefore, ANOVA, an analysis of variance and covariance computer program for investigating main effects was used to analyze the data. According to the data analyses, the following results are reported.

H_{0_1}: There will be no difference in a first grade child's performance ability on auditory perception Task 1 according to sex.

The results of the ANOVA tests on this main effect for Task 1 (Identities) showed that an $F = .639$ was non-significant at the .05 level. Null hypothesis 1 failed to be rejected.

H_{0_2}: There will be no difference in a first grade child's performance ability on auditory perception Task 2 according to sex.

The results of the ANOVA tests on this main effect for Task 2 (Individual Pitch Matching) showed that an $F = 1.983$ was non-significant at the .05 level. Null hypothesis 2 failed to be rejected. The addition of Task 1 as a covariate was non-significant as well.

H_{0_3}: There will be no difference in a first grade child's performance ability on auditory perception Task 3 according to sex.

The results of the ANOVA tests on this main effect for Task 3 (Tonal Pattern Matching) showed that an $F = 1.743$

was non-significant at the .05 level. Null hypothesis 3 failed to be rejected. Tasks 1 and 2 were found to be non-significant covariates with Task 3.

H_{0_4}: There will be no difference in a first grade child's performance ability on auditory perception Task 4 according to sex.

The results of the ANOVA tests on this main effect for Task 4 (Song Matching) show that an F = .662 was non-significant at the .05 level. Null hypothesis 4 failed to be rejected. The covariate analysis of Task 3 with Task 4 show that an F = 4.672 was significant at the .05 level.

H_{0_5}: There will be no difference in a first grade child's performance ability on auditory perception Task 1 according to age.

The results of the ANOVA tests on this main effect for Task 1 show that F = .119 was non-significant at the .05 level. Null hypothesis 5 failed to be rejected.

H_{0_6}: There will be no difference in a first grade child's performance ability on auditory perception Task 2 according to age.

The results of the ANOVA tests on this main effect for Task 2 show that F = 1.586 was non-significant at the .05 level. Null hypothesis 6 failed to be rejected. No significant covariance of Task 1 with Task 2 was found.

H_{0_7}: There will be no difference in a first grade child's performance ability on auditory perception Task 3 according to age.

The results of the ANOVA tests on this main effect for Task 3 show that F = 1.39 was non-significant at the .05 level. Null hypothesis 7 failed to be rejected. No significant covariate relationships were found.

H_{o_8} : There will be no difference in a first grade child's performance ability on auditory perception Task 4 according to age.

The results of the ANOVA tests on this main effect for Task 4 show that F = .961 was non-significant at the .05 level. Null hypothesis 8 failed to be rejected. Task 3 was found to be a significant covariate with Task 4 (F = 4.711) at the .05 level.

H_{o_9} : There will be no difference in a first grade child's performance ability on auditory perception Task 1 according to home environment.

The results of the ANOVA tests on this main effect for Task 1 show that F = .034 was non-significant at the .05 level. Null hypothesis 9 failed to be rejected.

$H_{0_{10}}$: There will be no difference in a first grade child's performance ability on auditory perception Task 2 according to home environment.

The results of the ANOVA tests on this main effect for Task 2 show that F = 1.799 was non-significant at the .05 level. Null hypothesis 10 failed to be rejected. No covariate significance was found.

$H_{0_{11}}$: There will be no difference in a first grade child's performance ability on auditory perception Task 3 according to home environment.

The results of the ANOVA tests on this main effect for Task 3 show that F = .385 was non-significant at the .05 level. Null hypothesis 11 failed to be rejected. No covariate significance was found.

$H_{0_{12}}$: There will be no difference in a first grade child's performance ability on auditory perception Task 4 according to home environment.

The results of the ANOVA tests on this main effect for Task 4 show that F = .475 was non-significant at the .05 level. Task 3 was found to be a significant covariate with Task 4 at the .05 level (F = 4.647).

$H_{0_{13}}$: There will be no difference in a first grade child's performance ability on auditory perception Task 1 according to Singing Ability 1.

The results of the ANOVA tests for the main effect on Task 1 show that F = .368 was non-significant at the .05 level. Null hypothesis 13 failed to be rejected.

$H_{0_{14}}$: There will be no difference in a first grade child's performance ability on auditory perception Task 2 according to Singing Ability 1

The results of the ANOVA tests for this main effect on Task 2 show that F = 1.137 was non-significant at the .05 level. No significant covariate effects were found.

$H_{0_{15}}$: There will be no difference in a first grade child's performance ability on auditory perception Task 3 according to Singing Ability 1.

The results of the ANOVA tests for this main effect on Task 3 show that F = 2.575 was non-significant at the .05 level. Null hypothesis 15 failed to be rejected. No significant covariate effects were found.

$H_{0_{16}}$: There will be no difference in a first grade child's performance ability on auditory perception Task 4 according to Singing Ability 1

The results of ANOVA tests for this main effect on Task 4 show that F = 5.330 was significant at the .05 level. Null hypothesis 16, therefore, was rejected. A significant covariate effect of Task 3 with Task 4 was also found (F = 4.478).

$H_{0_{17}}$: There will be no difference in a first grade child's performance ability on auditory perception Task 1 according to Singing Ability 2.

The results of the ANOVA tests for this main effect on Task 1 show that F = 1.783 was non-significant at the .05 level. Null hypothesis 17 failed to be rejected.

$H_{0_{18}}$: There will be no difference in a first grade child's performance ability on auditory perception Task 2 according to Singing Ability 2.

The results of the ANOVA tests on this main effect on Task 2 show that F = 2.367 was non-significant at the .05 level. Null hypothesis 18 failed to be rejected. No significant covariate effects were found.

$H_{0_{19}}$: There will be no difference in a first grade child's performance ability on auditory perception Task 3 according to Singing Ability 2.

The results of the ANOVA tests on this main effect on Task 3 show that F = .747 was non-significant at the .05 level. Null hypothesis 19 failed to be rejected. No significant covariate effects were found.

$H_{0_{20}}$: There will be no difference in a first grade child's performance ability on auditory perception Task 4 according to Singing Ability 2.

The results of the ANOVA tests on this main effect on Task 4 show that F = .005 was non-significant at the .05 level. Null hypothesis 20 failed to be rejected. No significant covariate effects were found.

$H_{0_{21}}$: There will be no difference in a first grade child's auditory perception performance ability according to task.

The results of the ANOVA tests for this main effect on Auditory Perception Performance Ability show that $F = 56.384$ was significant beyond the .01 level ($p < .0001$). Null hypothesis 21, therefore, was rejected.

Discussion

Of the twenty-one hypotheses tested, only two were found to be significant at the .05 level. The remaining nineteen identified that there were no significant differences in auditory perception ability with regard to sex, chronological age, home environment, (i.e., musical vs. non-musical) and singing ability.

Though an observance of any elementary music class will usually reveal a more positive response to music from a young girl than a boy, the findings of this study with respect to sex and auditory perceptual ability were not surprising. A study by Moore[11] found sex to be a significant variable only in a test of vocal range and ability in children of Kindergarten age.

The chronological age of the sample ranged from 77 to 99 months. However, all of the children were designated

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[11]Dorothy Louise Moore, "A Study of Pitch and Rhythm Responses of Five-Year-Old Children in Relation to Their Early Musical Responses", Unpublished Doctoral Dissertation, Florida State University, 1973.

as first graders. Though the findings of this study do not necessarily support previous research -- that auditory perception ability increases with age -- the research of Petzold[12], Updegraff[13], and Williams[14] used different grade levels of children (more than one level) as subjects for their research. A comparison across grade level was then analyzed. This was not the case in this study.

The effect of a musical or non-musical home environment on a young child's perceptual development is questionable. Though Kirkpatrick[15] noted a significant difference in the singing ability of young children from 'musical' home environments, the problem lies with the definition of what constitutes a 'musical' environment? Furthermore, what may be musical and positive for one child may be detrimental for another. The presence of singing and playing, in the home, may not necessarily foster a positive musical atmosphere.

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[12]Petzold.

[13]Ruth Updegraff, Mary Elizabeth Keister, Louise Heiliger, and Janet Learned, "Studies in Preschool Education I", University of Iowa Studies in Child Welfare, Vol. XIV, 1937.

[14]Williams.

[15]William C. Kirkpatrick, Jr., "Relationships Between the Singing Ability of Prekindergarten Children and Their Home Musical Environment", Unpublished Doctoral Dissertation, University of Southern California, 1962.

The findings with respect to singing abilities and auditory perception ability that resulted from this study were both positive and negative. That is, the fact that too much past research in the field of auditory perception/ discrimination has required a vocal response from a young child was what prompted this study. A need for new measures of auditory perception abilities in young children is apparent especially if the older measures (e.g. sung) require a special ability in themselves. These findings point the way for non-verbal, non-vocal response modes.

At the same time, however, one would think that the ability to perceive individual tones and groups of tones (patterns) through one type of response would be aided by the ability to sing the same. Studies by Zwissler and Boardman[16] have alluded to this premise. It had been hoped that the findings of this study would identify pitch matching skills of young children regardless of their ability/ inability to sing. However, it was also hoped that those children who had a certain singing ability would achieve at a significantly higher level. This was only the case with respect to Task 4 - the manipulation of tones to create a familiar song phrase.

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[16]Eunice Boardman, "An Investigation of the Effect of Preschool Training on the Development of Vocal Accuracy in Young Children", Unpublished Doctoral Dissertation, University of Illinois, 1964.

Implications of the Study

This study sought to identify the influence of selected variables (namely, sex, age, home environment, singing ability) on certain auditory perceptual skills of young children. Though the majority of the findings indicated little or no relationship between the variables and the criteria, perhaps at this early age (first grade) the effects of these variables are minimal. Conversely, the techniques and instruments developed for the study were highly successful with this age level. That is, the use of non-verbal, manipulative devices for the identification of pitch-matching abilities of children seemed more appropriate than previously mentioned methods. The use of verbal and vocal responses is not to be disregarded at this level, but more aptly used as an alternative or comparative method.

Though the four tasks measured were found to identify different pitch matching abilities, an investigation of the individual items (within each task) reveals some interesting data. That is, Tasks 1 and 2 (items 1-12) enjoyed a high level of achievement by the subjects. The means for Items 1-6 and 7-12 were 4.3 and 4.2 respectively. These items measured the ability to match single tones (pitches). The implications from Task 3 (items 13-24), which required both a discrimination process and a matching (manipulation) process involving a group of tones (three or more), indicated that it was easier to discriminate a pattern of sounds ($\bar{x}$ = .61) than

to reproduce it ($\bar{x}$ = .36). (A graphic comparison of these two abilities is found in Figures 4-4 and 4-5). The issue regarding individual pitch matching ability versus pattern matching ability demands further investigation before stating that the development of one such ability precedes the other.

Another implication of the study was the need to thoroughly investigate a particular design prior to its implementation. In this study the creation of unequal cell sizes due to the blocking effect of the age variable caused the unsuccessful use of the MANOVA program. Though the interactive effects of age, sex, and tasks could be questioned in this study, this data was not available through the ANOVA program.

A third implication of the study was the lack of discriminative evidence regarding the categorization of the home environment as being either 'musical' or 'non-musical'. The variables of sex and age can be easily differentiated but the question of whether or not a home environment furnishes a positive atmosphere toward music cannot be answered from responses to selected questions. The minimal research that relates to home environment factors and music indicates that a positive relationship exists - even in young children. What is necessary is a definitive, diagnostic tool that best defines the characteristics and experiences that foster a positive, musical atmosphere in the home.

A final implication was the important place for music education research in the public schools. Much interest and enthusiasm was received from the administrators, teachers and children involved in the study. With the Pitch-in-a-cans the children felt challenged and yet unafraid when responding to the various tasks. The children looked forward to each new week's game. (When asked for a vocal response, (T_3,T_4) many shied away and had to be coaxed. Others refused to answer at all.) Those children not included in the study pleaded to be selected for the next week.

To conclude, the significance of this study lies more in the processes followed than in the products resulting. Namely, it was significant that the Pitch-in-a-cans were developed. They represent a new way of furnishing children with movable (musical) sounds. It was also significant that the Pitch Matching Abilities Tasks used these 'cans' to identify different auditory perception abilities in children. The combination of these two instruments allowed for the measurement of perceptual abilities through non-verbal, overt processes. The significance of this aspect of the study can only be realized through further research - research in the identification of auditory perception abilities using non-verbal, manipulative measures. Most important, it was significant that the subjects enjoyed participating in the study. The manipulation of the 'cans' and responses to the various tasks represented another way of allowing people to interact with musical sounds.

Implications for Further Research

The findings of this investigation suggest replication of the study with subjects from varying grade levels (e.g., K, 1, 2). In addition, the following research is recommended:

1. A replication of the study using only one task (e.g. T_1) to identify discernable pitch differences (DL) of young children.

2. A replication of the study using several tasks but with two groups of subjects. One group using the manipulative, non-verbal response mode and the other, a verbal, descriptive response.

3. A replication of the study with older subjects, perhaps through grade five and an investigation of any differences across sex with these subjects.

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APPENDICES

A P P E N D I X A

Date

Principal
Address

Dear _____:

My name is Louise Patrick and I am currently a doctoral student in Music Education at Michigan State University. I am presently working on my dissertation, entitled: "An Investigation of the Pitch-Matching Abilities of First Grade Children". I am also a friend of your music teacher, _____.

I would like to request your permission to use about ten first grade children from _____ Elementary School as subjects for my research. I would plan to come to your school several times during the month of May (at your convenience) and play a series of musical 'games' with these children. The process would be on an individual basis - each student receiving about five minutes of 'games' during each visitation. This would minimize the amount of class time they would miss. The only other request I would ask is that of a small room in which to conduct these measurements.

I have discussed this project with _____ and she seemed to think that the children would enjoy the experience. Her involvement would only entail a short explanation of my presence and hopeful encouragement, on the part of the children, to try their best. I hope you will consider my requests and agree to involve the children of _____ Elementary School. I will plan to call you on _____ at _____ in the morning to discuss any questions you may have. If you are unable to be in your office at this time, please leave a message so I may contact you later. Thank you for your attention to this matter.

Sincerely,

Louise Patrick

Date:

Dear parents:

I would like to thank you for allowing your child, _____, to participate in the music project I conducted at _____ School. All of the children involved seemed to enjoy the experiences and they did very well on the various pitch-matching tasks. I hope you will continue to encourage your child to enjoy music - both at home and in school.

Sincerely,

Louise Patrick

Date:

Principal
Address

Dear :

I would like to take this opportunity to thank you, your first grade teachers _____, your terrific kids, and of course, _____, for allowing me to include _____ Elementary School in my sample of Michigan schools. Everything seemed to go well - and the children enjoyed the musical tasks. The remainder of the class wanted to 'play with the cans' too!

I hope the school year ends smoothly and that you have a good summer vacation. Again, thanks for everything.

Sincerely,

Louise Patrick

A P P E N D I X B

HOME ENVIRONMENT INFORMATION

1. Student's name _____

2. Birthdate: _____ Total Mos.____
   Month Day Year

3. Does _____ play any musical instrument? Yes No

   What? _____ How long? _____

4. How many brothers and sisters live at home? _____

5. Do any of them play musical instruments? Yes No

   How many? _____ What? _____ How long? ___

6. Does the mother play any musical instrument? Yes No

   What? _____

7. Does the father play any musical instrument? Yes No

   What? _____

8. Do either play in the home? Yes No

9. Does the mother sing in church/recreational group or other choir? Yes No

10. Does the father sing in church/recreational group or other choir? Yes No

11. Do the parents sing in the home? Yes No

12. Do either of you sing (regularly) with the child? Yes No

13. Does the family own a record player and records? Yes No

14. Is active listening (to recordings) encouraged in the home? Yes No

15. Does the family attend any musical events, concerts, etc.? Yes No

School Name _____

TOTAL POINTS:

HOME ENVIRONMENT INFORMATION

Question No. and	Description	Springview	Coopersville	Hughes	Pepper	Total	%
3	Subject play and musical instrument	1			1	2	05
5	Brothers/sisters play any instruments	2	4	2	2	10	25
6	Mother play any instrument (home)		2	4		6	15
7	Father play any instrument	4	1	2		7	18
9	Mother sing in choir		3			3	07
10	Father sing in choir		1			1	02
11/12	Parents sing in home with child	9	10	11	6	36	90
13/14	Record player/records in home	10	10	10	9	39	98
15	Musical concert/events attendance	7	7	7	6	27	68

MUSICAL BACKGROUND STATISTICS

(N = 40)

SUBJECT DESIGNATION

School	Subject No.	Musical	Non-Musical
Springview	1		x
	2		x
	3		x
	4		x
	5	x	
	6	x	
	7	x	
	8		x
	9	x	
	10	x	
Pepper	11		x
	12		x
	13		x
	14		x
	15	x	
	16		x
	17		x
	18		x
	19		x
	20		x
Hughes	21		x
	22	x	
	23	x	
	24		x
	25	x	
	26		x
	27	x	
	28	x	
	29	x	
	30		x
Coopersville	31		x
	32	x	
	33		x
	34	x	
	35	x	
	36	x	
	37	x	
	38		x
	39	x	
	40	x	

On the basis of a numerical score the subjects were designated as coming from a 'musical' home environment or a 'non-musical' home environment. Scores were compiled from data collected on the Home Environment Questionnaire. Questions were weighted according to a study by Kirkpatrick which cited specific home activities that seemed to relate to musical responses from school children.

Question No.	Point Value
3	2
5	1 each
6	1
7	1
8	1
9	2
10	2
11	2
12	2
14	1
15	1

A P P E N D I X C

PILOT STUDY #2 RESPONSES

Classroom #1	Responses (+ or -)	No Response
Donna	4	
Kelly	4	
Kenny	4	
Mike	4	
Brent	4	
Sara	4	
Classroom #2		
Beth	4	
Tiffany	3	1
Michael	4	
Billy	4	
Renee	4	
Todd	2	2
Classroom #3		
Lauren	4	
Robbie	3	1
Doug	3	1
Susie	4	
Doug	4	
Michelle	4	

TASK TOTALS

	TASK 1	TASK 2	TASK 3	TASK 4
No. of students	18	12	12	9
No. of items tried	4	3	3	1
% of items correct	70%	50%	40%	50%

A P P E N D I X D

Script

Task 1

Introduction to Pitch-in-a-cans (Cahpter III - Procedures)

"Now that you know how to make the cans 'sing' we can play my first game. (Slide three cans in front of child) How many cans do you have in front of you? (Three) Good. Here's how the game is played. Listen to each can very carefully and I want you to point to (or pick out) the can that doesn't sound like the other two. Listen. (Pick up each can, each about three seconds.) Can you point to the can that doesn't belong? (Repeat listenings if child is unsure.) Good. Now I will mark that you picked the correct can (Mark on answer sheet 1 = correct, 2 = incorrect). Let's try another - close your eyes and I'll switch the cans around. (Continue this process for all items - with items 4 thru 6 allow the children to pick up the cans and choose.)

Task 2

"Hi _____. Do you remember how to make the cans sing? Good. I have a new game today, are you ready? (Slide three cans in front of student.) How many cans do you have in front of you? (Three) Good. I have one can. Here's my game. You listen very carefully to the sound of my can and then listen to each of yours and find one that sounds just like mine. Listen to this can (stimulus). Can you find one in this group (point to child's three cans) that sounds just like this one? (Allow child to listen to each of his/her cans and if required play stimulus can again.) Scoring: 1 = correct, 2 = incorrect. Very good. Now what do I have to do? (Child will say move the cans around.) (Continue this process for all items) (Upon completion select four cans - C,E,G,A) Listen to this can (C) - can you buzz (or hum) like it? Score: 1 = yes, 2 = no. Do same for E,G, and A.

Task 3

"Today I have a new game. You have three cans in front of you. They are numbered (from left to right) 1, 2, and 3. When the time comes I want you to pick them up in that same order. Here's my game: I will play a short tune on the glockenspiel (demonstrate) and then you pick up your cans and decide if they play the same tune. Listen. (Play G-E-G). You pick up your three

cans and see if their tune is the same. (Child picks up cans) If you need to hear my tune again let me know. (Scoring: 1 = if order is correct, and student says yes; if order is incorrect, and students say no. 2 = incorrect response.) (In five of the six tunes the order of the cans was incorrect. The student was encouraged to rearrange the cans so that the tune matched the one played by the researcher. Unlimited listenings of the stimulus tune were provided. Scoring: 1 = correctly manipulated cans to match stimulus tune, 2 = incorrectly manipulated cans.

Task 4

"You sing songs during music class, don't you? Do you know the song - This Old Man or Twinkle, Twinkle, Little Star? Can you sing it for me? I'll start the song with you if you wish. (Allow child to sing song - in his/her own range.) Very good. (Score: 1 = sung recognizably and in tune, 2 = sung with some discrepancies, 3 = no response). Here are _____ cans. Can you arrange the cans to sing the first part of your song? (Allow time for child to manipulate cans. Score: 1 = correct, 2 = incorrect) Do you know the songs Are You Sleeping or Three Blind Mice? Can you sing one for me? Score as above. Here are _____ cans. Can you arrange these cans to sing your song? (first phrase) Score as above. Very good. Thank you very much for participating in my games. I hope you enjoyed them. Good-bye."

A P P E N D I X E

VARIABLES 1-20

	Subject	Sex	Home Environment	Age (Months)	Task 1	Task 2	Task 3	T_4	T_1	T_2	T_3	T_4	Match & Pitch	Sing tunes
Springview	01	2	2	80	221211	221121	121212121212	12	03	03	00	01	2	1
	02	2	2	81	111112	122222	222212111212	22	05	01	01	02	1	1
	03	2	2	84	121211	112212	111112111212	22	04	03	03	00	1	1
	04	2	2	83	212221	121122	221112221212	12	02	03	01	01	1	1
	05	2	1	80	121111	111111	333333333333	13	05	06	0	01	1	1
	06	1	1	93	112122	111112	333333333333	13	03	05	0	01	2	2
	07	1	1	87	111112	112111	221212122222	22	05	05	01	00	2	2
	08	1	2	90	111121	111121	221211222212	33	05	05	01	00	3	3
	09	1	1	83	112121	112111	222222111211	22	04	05	02	00	1	1
	10	1	1	87	121121	111122	222211111211	22	04	04	03	00	2	1
Pepper	11	2	2	89	112111	111111	221122112222	33	5	6	2	0	2	1
	12	2	2	81	111212	112212	111111111111	21	4	3	6	1	1	1
	13	2	2	88	111212	111111	221112111112	11	4	6	3	2	1	1
	14	2	2	83	121212	122112	111211111122	12	3	3	4	1	1	1
	15	2	1	83	111111	121111	111111111111	21	6	5	6	1	1	1
	16	1	2	86	112111	111111	122222111211	21	5	6	2	1	2	1
	17	1	2	78	111111	112211	111212112112	11	6	4	2	2	1	1
	18	1	2	82	111121	112211	112222112222	32	5	4	2	0	2	1
	19	1	2	99	111111	111122	222222112222	22	6	4	1	0	1	1
	20	1	2	82	121112	111111	333333333333	33	4	6	0	0	2	3
Hughes	21	2	2	81	112121	112211	221212112112	11	4	4	3	2	1	1
	22	2	1	83	121112	211111	111212112112	22	4	5	2	0	2	1
	23	2	1	89	111111	112112	222221222222	22	6	4	0	0	2	1
	24	2	2	83	111221	122112	333333333333	23	4	3	0	0	1	2
	25	2	1	78	121121	112111	222222112222	22	4	5	1	0	2	1
	26	1	2	79	112211	112122	122212111222	22	4	3	1	0	1	1
	27	1	1	87	121222	211112	121212222212	11	2	4	0	2	2	2
	28	1	1	92	111112	122112	112212222222	22	5	3	1	0	3	3
	29	1	1	91	212212	111111	121212112222	33	2	6	1	0	2	2
	30	1	2	79	111112	221211	111112211211	22	5	3	4	0	2	2
Coopersville	31	2	2	87	122211	112211	112222112222	22	3	4	2	0	2	2
	32	2	1	79	121212	122111	121121111111	22	3	4	4	0	1	1
	33	2	2	89	111112	121122	111221121112	22	5	3	3	0	2	1
	34	2	1	81	111111	112111	111111111112	11	6	5	5	2	1	1
	35	2	1	79	221112	121222	112212222222	22	3	2	1	0	2	1
	36	1	1	89	212121	111122	221122112222	22	3	4	2	0	1	2
	37	1	1	97	111111	122112	222222112222	33	6	3	1	0	2	3
	38	1	2	77	111112	111111	111111211111	21	5	6	4	1	2	2
	39	1	1	84	121121	111212	111122211211	33	4	4	4	0	2	3
	40	1	1	84	111111	111111	111212112111	11	6	6	3	2	1	2