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An experimental study of relationships among music listening abilities in formally and informally trained musicians

Panion, Henry, III, Ph.D.
The Ohio State University, 1989

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AN EXPERIMENTAL STUDY OF
RELATIONSHIPS AMONG MUSIC LISTENING ABILITIES IN
FORMALLY AND INFORMALLY TRAINED MUSICIANS

DISSERTATION

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

By

Henry Panion, III, B. S., M. A.

*****

The Ohio State University

1989

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To my loving wife, Karyl, thanks for sacrificing, caring and understanding. This dissertation is dedicated to you.

Finally, to my Lord and Savior, Jesus Christ, I offer a special thanksgiving; for in Him all things are possible.
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*Everybody Don't Know Who Jesus Is.* The TETREC Choir. Tyscot Records: Indianapolis, IN; 1986.


*Upon This Rock.* The TETREC Choir. Tyscot Records: Indianapolis, IN; 1988.
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CHAPTER I

THE NATURE AND PURPOSE OF THE STUDY

INTRODUCTION

Earlier research has shown that some music listening abilities are equally shared between musicians with extensive formal training and those with little to no formal training.\(^1\) This earlier research examined the listening abilities absolute pitch, relative pitch, tonic identification and melodic identification. While it was originally assumed that musicians with formal training would perform better overall on all of these tasks than musicians with no formal training, I assumed that the informally trained musicians would perform better on certain of these tasks than might typically be expected. Furthermore, I expected that the existence or nonexistence of certain of these abilities would correlate highly with the existence or nonexistence of others.

Interest in this subject matter grew out of years of observing musicians in the classroom and various church and community gospel ensembles. Because of my experience as an arranger, conductor and college aural skills teacher, I have noticed continuously that musicians

\(^1\)Panion, 1983.
who lack formal training often possess acute levels of music listening abilities.

Most gospel music sung by church and community choruses is taught by rote. Few members, if any, in these ensembles possess useful music reading ability. Furthermore, most of the music sung by these choirs has been not scored. Therefore, when directors decide to teach songs, they rely heavily on their musicians' ability to play by ear. Typically, a recording of a tune is first given to the soloist and instrumentalists to learn, after which it is taught to the choir.

I have noticed on many occasions informally trained singers and instrumentalists who possess a seemingly uncanny ability to improvise and memorize melodies and chords, though they lack the ability to read music. Furthermore, many of them do not understand the terminology used to describe such musical constructs as scales and chords. Yet years, even life-times, of learning music by rote has been most effective in developing their music listening skills.

There is an inherent frustration that accompanies teaching aural training: The correlation between students' development and the amount of time they spend in an aural training lab is not always a strong one, even after every trick of the trade has been imparted by the teacher. I presumed that if I could identify music listening traits in both the informally and formally trained musician, pedagogical techniques for aural skills would be enhanced.
The present research is based on findings reported in the authors' master's thesis. These results suggested that:

1. Absolute pitch ability has at most a weak relationship with relative pitch ability.

2. Absolute pitch does not relate to tonic identification or melodic identification.

3. Relative pitch relates strongly to tonic and melodic identification, but only in trained musicians.

4. Tonic identification has a very strong relationship with melodic perception.

5. The abilities of absolute pitch, relative pitch and melodic production (dictation) have a higher level of existence in trained musicians than in untrained musicians.

6. Tonic identification and melodic recognition are stronger in untrained musicians than absolute pitch or relative pitch.

7. Both trained and untrained musicians perform better on recognition response tasks than on production response tasks.

8. Tonic identification is found in more people than any of the other musical abilities tested.
In contrast to the relatively small subject population in the earlier study, the number of subjects in the present study is virtually doubled. The music listening ability of chord identification is added to the original model, and its effects are analyzed. Finally, the earlier study sought the existence of only two-directional relationships between these listening abilities. The current experiment tests for the effects that possessing more than one of the abilities of absolute pitch, relative pitch, tonic identification, chord identification and melodic identification may have on each other.

PURPOSE

It is the purpose of this study to:

1. Review published experimental research and standardized tests that measure differences and relationships among the abilities absolute pitch, relative pitch, tonic identification, chord identification and melodic identification.

2. Administer tests of absolute pitch, relative pitch, tonic identification, chord identification and melodic identification to groups of formally and informally trained musicians.

3. Compare scores on these ability measures within and between both groups of musicians.
4. Compare scores on these measures for two types of responses: recognition and production.

HYPOTHESES

The following hypotheses resulted from findings reported in the authors' master's thesis and from continuous observations made while working with both informally and formally trained musicians.

1. Mean scores of trained subjects will be significantly higher than mean scores of untrained subjects on tests of absolute pitch.

2. Mean scores of trained subjects will be significantly higher than mean scores of untrained subjects on tests of relative pitch.

3. Mean scores of trained subjects will be significantly higher than mean scores of untrained subjects on tests of tonic identification.

4. Mean scores of trained subjects will be significantly higher than mean scores of untrained subjects on tests of chord identification.
5. Mean scores of trained subjects will be significantly higher than mean scores of untrained subjects on tests of melodic identification.

6. Relative differences among tests of music identification will not be the same between groups of trained and untrained musicians.

7. Variation in absolute pitch ability will not be accounted for by performance on tests of relative pitch, tonic identification, chord identification and melodic identification, and training.\(^2\)

8. Variation in relative pitch ability will be accounted for by performance on tests of chord identification and melodic identification, and training.

9. Variation in tonic identification ability will not be accounted for by performance on tests of absolute pitch, relative pitch, chord identification and melodic identification, and training.

10. Variation in chord identification ability will be accounted for by performance on tests of relative pitch, chord identification and melodic identification, and training.

\(^2\)The author warns that while appropriate tests may account for conditions under which certain music listening abilities might exist, they are unable to determine the cause for their existence.
11. Variation in melodic identification ability will be accounted for by performance on tests of relative pitch and chord identification, and training.

12. Mean scores on absolute pitch tests will not relate strongly and positively to mean scores on tests of tonic identification, chord identification and melodic identification.

13. Mean scores on relative pitch tests will relate strongly and positively to mean scores on tests of chord identification and melodic identification.

14. Mean scores on tonic identification tests will not relate strongly and positively to mean scores on tests of relative pitch, chord identification and melodic identification.

15. Mean scores on chord identification tests will relate strongly and positively to mean scores on tests of melodic identification.

DEFINITION OF TERMS

**Absolute Pitch** The ability to recognize (i.e., passive absolute pitch) or produce (i.e., active absolute pitch) the pitch of any tone, regardless of timbre, without the aid of an external reference.

**Chord Identification** The ability to recognize or produce chord qualities on demand.
Formally Trained Individuals whose skills were acquired in a rigorous and controlled academic environment.

Informally Trained Self-taught individuals; primarily, those whose skills are not acquired in an academic environment.

Melodic Identification As used in the present study, this term refers to the ability to recognize or produce melodies through traditional music notation.

Perception The awareness and judgment of a sensation, mediated by prior knowledge.

Relative Pitch The ability to recognize or produce the pitch of any tone, given a reference pitch.

Tonic Identification The ability to recognize or produce the tonal center when listening to a tonal musical composition.

Trained and Untrained As used in the present study, these are synonymous with formally and informally trained, respectively.
LIMITATIONS OF THE STUDY

This study will be limited to the following:

1. A review of published experimental research and standardized measures of musical ability that test for one or more of the abilities investigated in the present study.

2. An investigation of differences and relationships among the abilities of absolute pitch, relative pitch, tonic identification, chord identification and melodic identification.

3. A comparison of results between formally and informally trained musicians.


5. There will be no attempt to test the effects that age, gender or race might have on performance on these tests.
CHAPTER II

REVIEW OF LITERATURE

INTRODUCTION

The present review addresses studies that report on relationships among the abilities of absolute pitch, relative pitch, tonic identification, chord identification and melodic perception, and the effect(s) that formal training may have on any of these. While much research literature implies that relationships among certain music listening abilities exist (i.e., that subjects may use other music listening abilities in completing specific tasks), no empirical studies were discovered that have tested for these relationships.

The second segment of this review examines standardized tests, or portions thereof, that test for any of the abilities measured in the present study. While there are a number of published correlational studies that report on the reliability and validity of various standardized tests, it is beyond the scope of this review to discuss these studies, or to take the present test through such procedures of validity and reliability.
BASIC RESEARCH LITERATURE

While tests can be designed to measure the results of a given musical activity, it is often difficult to identify the exact abilities subjects use in completing specific tasks (Panion, 1983). This problem is especially true in measuring absolute pitch (Petran, 1932, Ward & Burns, 1982).

In an attempt to identify certain traits that might distinguish absolute pitch possessors (AP) from others, Siegel (1972) tested several hypotheses: (1) The Local-Discrimination Hypothesis, that AP is a result of the perception of pitches at specific points along the continuum, rather than across the entire frequency range; (2) the Generalized Memory for Pitch Hypothesis, that AP possessors may store pitch information in memory; and (3) the Internal-Standard Hypothesis, that AP possessors may compare musical notes to internal reference tones. Results failed to show whether responses were based on either sensory discrimination or an internal reference. However, Siegel observed that accuracy levels were highest when stimulus tones were repeated immediately and declined as the number of presentations increased before a tone was repeated, thus suggesting that subjects attempted to memorize pitches they heard.

If musicians use an internal reference tone to complete absolute pitch tasks, they have unquestionably generated their responses via relative pitch. In fact, it is quite plausible that certain musical
circumstances may aid some musicians in developing these references. For example, an oboe player who has tuned orchestras to A440 for 25 years may possess a strong ability to identify this pitch. However, most experimental designs measure only the given response and not the method used to arrive at a particular response. Thus, if an individual can retain one or more pitches in memory indefinitely, these individuals may be able to generate responses via a relative pitch ability.

In an attempt to replicate Siegel's study, Costall (1985) tested both musicians and non-musicians. Subjects were classified as non-musicians if they lacked experience as an instrumentalist or singer. Costall discovered that not only were responses more accurate for trials where tones were repeated immediately, but that musicians responded more accurately when subsequent stimuli were in close proximity to tones previously presented. Non-musicians performed equally poorly under both conditions.

These results indicate that relative pitch possessors may perform well on absolute pitch tasks, provided an anchoring technique is exhibited, regardless of whether or not they possess genuine absolute pitch ability.

Costall asserts that the ability merely to perceive pitch, in and of itself, is not a very meaningful one; however, both he and Siegel apparently overlooked the fact that the perception of mere frequency ratios is not pertinent to the perception of music, especially when
these ratios are extraneous to constructs in Western tonality. Costall states that "it makes little sense for the listener to treat pitch as an entity in itself since, typically, pitch constitutes merely the medium of meaningful structures, be they musical or otherwise. To attend to pitch as such would be to mistake the medium for the message."\(^1\) Yet, by requiring subjects to judge pitches and intervals extraneous to the tonal system, both Costall and Siegel establish their conclusions on such unmusical associations.

In a similar study, Rakowski (1972) tested the effect of absolute pitch on the ability to reproduce a given tone. Musicians with and without absolute pitch adjusted the frequency control of a tone generator in an attempt to match the pitch of a stimulus tone at time intervals of 5, 10, 25 and 60 seconds, 5 and 30 minutes, and 24 hours. Marked decrements in response accuracy levels were observed between these groups at 5 minutes and beyond.

When the pitch of the standard tone could no longer be held in memory, musicians without absolute pitch simply guessed, while those with absolute pitch completed the task more successfully by comparing the stimulus to tones of the musical chromatic scale. Frequencies that corresponded to tones of the musical system (e.g., 110 Hz) generated more accurate results than those outside the system. Musicians with absolute pitch were able to match pitches

\(^1\)Costall, 1985, p. 192.
relative to these frequencies after any time period. In contrast, response accuracy to tones outside the system (e.g., 1000 Hz) were similar to those made by subjects without absolute pitch.

Bachem (1954) suggests there exist no significant differences between the abilities of possessors and non-possessors of absolute pitch at making comparison judgments after short time intervals, and in a similar study observed a better performance by non-possessors at relative pitch discriminations. He submits that chroma identification plays no role in pitch perception at short time intervals and that AP possessors shift from relative pitch to chroma identification at other times.

Taking into consideration the unmusical nature of these experiments, the assumption that musicians with absolute pitch might perform better than non-possessors on any pitch identification tasks is challenged, nevertheless. If there is a musical advantage to having absolute pitch, it does not reside in simply possessing this ability. Rather, this advantage is only maximized when AP is coupled with other music listening abilities. Furthermore, in true musical situations, other abilities may indeed play a more important role than AP. Balzano declares, "... it is the perception of patterns and relations the tones enter into and not the sensations of tones themselves that accounts for our ability to appreciate music... The sensations of tone may well be a function of frequency and frequency ratios, but the perception of music need not be, and indeed appears instead to be a
function of higher-order properties of pitch sets that are independent of ratios.\textsuperscript{2}

Carroll (1975) indicates that any pitch discrimination superiority absolute pitch subjects may possess over non-absolute pitch subjects may decrease with experimental designs that resemble typical music settings. Carroll tested nine subjects' abilities to match randomized tape-recorded piano tones by rapidly striking the keys of a piano. He observed that both AP and non-AP subjects' accuracy levels increased when the size of stimulus sets decreased. Both groups appeared to make relative pitch judgments when note ranges were small, 16 opposed to 64 semitones. While the smaller range may have aided subjects in discriminating random pitches, accuracy levels would increase even more, provided subjects were to make these same deductions from real music examples. In fact, the mere number of tones perceived would indubitably increase as well.

Most measures of absolute pitch fail to account for the complexities that individuals with multiple music listening abilities bring to music perception. Furthermore, the degree to which each of these co-existing skills may influence particular responses is typically not considered, as well.

Several studies have been reported that purport to show the interrelations between absolute pitch and tonic identification. Corso

\textsuperscript{2}Balzano, 1982, pp. 348-349.
(1957) measured college musicians’ abilities to identify keys by virtue of absolute pitch. Subjects were presented a series of three tests: test 1 comprised ascending major and minor scales; on test 2, the tones of each scale were randomized in each key; and subjects were presented the chord progression I IV V7 I in each key on test 3.

The author observed that in test 2, the most accurate responses to the random patterns occurred in C major and F major and concluded that subjects are better at identifying these tones and chords. However, upon analyzing the stimuli, it becomes clear that out of the 24 patterns, only those in C and F major resemble prototypical melodies of Western culture. Consequently, under these conditions it is certainly possible that subjects’ responses were based on relative pitch or tonic identification, or a combination of both. Corso does report that subjects indicated they attempted to make relative pitch judgments by referencing other notes, e.g., “a lowest singing note,” “middle C” or “concert A.” The one subject reported to have absolute pitch only obtained a 65% accuracy level on test 2, while achieving 100% and 92% on tests 1 and 3, respectively.

While performance levels on test 1 were highest of all, the accuracy level, evaluated with information theory, was substantially less than the amount of information presented, 1.02 bits transmitted out of 4.58 bits (12 major and 12 minor keys) presented.\(^3\) Subsequently, the

\(^3\)Several authors offer discussions supporting the use of information theory in measuring absolute pitch ability, e.g., Carroll (1975); Ward & Burns (1982) and Rush (1989).
inclination here that the perception of scales or chords may determine an individual's ability to make absolute judgments of tonality is not substantiated.

Corso did acknowledge that these results failed to demonstrate persuasively that every key possesses certain inherent characteristics that distinguish it from all others. Subsequently, he suggested that the perception of "musical tonality is based on a minimal number of cues," and that "judgments of musical tonality are probably multi-dimensional and influenced by set."4

One final set of studies on individuals' ability to make absolute judgments of key characteristics is worth discussion. Terhardt & Seewann (1983) propose that in tonality perception, absolute pitch possessors depend solely on pitch identification while non-absolute pitch possessors "unconsciously deduce from a series of notes a feeling of key."

In an experiment which replicated and expanded an earlier study by Terhardt & Ward (1982), subjects were tested on their ability to determine whether musical excerpts of preludes from Bach's *Well-Tempered Clavier* were transposed or played in their original key.

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4Studies reported by Brown and Butler (1981), Butler (1982) and Brown (1988) provide convincing argument that there are elements inherent in the tonal system that are more influential on tonic perception than isolated scales and chords. This subject matter is discussed later in this chapter.
The authors dismissed the possibility that results by both AP and non-AP possessors could have been based on relative pitch. While there are properties within the tonal system that influence tonic perception, these properties are not key specific, but operate in every key. Therefore, if AP and non-AP possessors can perceive these operants, tonic identification is at both their disposal. Only then can other abilities, be they absolute pitch or relative pitch, be used to facilitate absolute judgments of particular keys, but not as these authors suggest.

Few tests have employed correlation coefficients as a basis for measuring relationships between absolute pitch and other attributes (e.g., Gough, 1922; Rush, 1989). However, in both studies, authors tested for relationships between training methods and absolute pitch ability and not for significant relationships among various listening abilities in musicians.

Research on interval perception is vast. More emphasis has been placed on the scientific basis of interval perception than on its usefulness to the perception of music (Burns & Ward, 1982). However, only a small amount of this research considers the effects that the coexistence of other musical listening abilities might have on relative pitch, or vise versa, and no studies have tested for specific relationships. Furthermore, these studies have usually required subjects' responses be limited to same vs. different judgments, rather than specific interval size discriminations.
Several studies suggest that in particular music situations, interval identification is germane to melodic identification (e.g., Dowling & Fujitani, 1971; Dowling & Bartlett, 1981; Edworthy, 1985; Dowling & Harwood, 1986). In this group of studies, the effects of contour and interval perception on subjects' ability to remember melodies were tested. Primarily, results from these studies indicate that often in long-term memory tasks (e.g., remembering familiar melodies), listeners rely more on specific interval identification than on memory of melodic contour.

In one of these studies, Dowling and Bartlett (1981) required subjects to remember melodic excerpts from various Beethoven String Quartets. Subjects were presented a melody and after a 5 minute pause were presented either an exact repetition of the original melody, a melody based on imitation, a melody with only the original contour retained, and a totally different melody. They were tested on their ability to identify each. Results showed that listeners were able to distinguish the exact repetitions from the completely different melodies with 75% accuracy, while performing at only the 50% level when comparisons were made between imitation and different melodies. As a result, the authors concluded that the ability to recognize interval sizes is operational in remembering melodies over a long period of time, even in listeners with minimal listening experience.
It is important to point out that recognizing a difference between intervallic distances of tones is not the same as pinpointing what the specific interval distances are, and whether a melody is stored in long or short-term memory may or may not play a significant role in discriminating the different intervallic relationships the pitches form. For example, given the presentation of the National Anthem at any sports event, most Americans, undoubtedly, would quickly identify an existing wrong note. However, only a few would be able to label that wrong note and replace it with the correct one. And while the importance of perceiving isolated intervals in melodic perception has been questioned (i.e., Burns & Ward, 1982), this association of abilities represents tasks music educators and performers encounter daily. Furthermore, while both musicians and non-musicians may use similar processing techniques in music perception, the level at which musical information is processed is contingent upon the level of the ability or abilities needed to complete the task (Sloboda & Parker, 1985).

There is concern with the effect that interval sizes may have on subjects' ability to perceive melodies (e.g., Attneave & Olson, 1971; Bregman & Campbell 1971; Deutsch, 1972, 1978a, 1978b). Attentiveness to relationships among tones in a melody forms a significant part of perceiving that melody. Deutsch (1978a) suggests that listeners process not only the individual tones heard in a melody but the melodic intervals between each tone as well, and proposes further that melodies composed of intervals that are easily processed
generate higher levels of perceptual accuracy. She reports an experiment in which subjects were presented a series of two tones from an equal-tempered scale. Presentations of tone pairs were interrupted by melodic sequences of varying order and intervallic construction. Results indicate that subjects' accuracy levels were highest when sequences were constructed of small melodic intervals, suggesting, seemingly, the existence of a strong relationship between relative pitch and melodic perception abilities.

Another line of reasoning submits that the relationship between pitch positions in the octave and interval sizes plays an important role in melody recognition (e.g., Deutsch, 1972; Idson & Massaro, 1978; Kallman & Massaro, 1979). In one study (Idson & Massaro, 1978), subjects were presented a series of familiar melodies: *Happy Birthday*, *London Bridge*, *Pop Goes the Weasel*, *On Top of Old Smokey* and *God Rest Ye Merry Gentlemen*. Each melody was presented in its original form as well as in several melodic transformations. In OPC (Octave Preserve Contour), component tones were displaced and octave, but the contour was preserved. In OVC (Octave Violate Contour), tones were displaced an octave and the contour was altered by reversing the direction of approximately every other successive interval. In PC (Preserve Contour), melodies were played in the original octave with the contour retained, while successive tones were chosen randomly. And in LT (Linear Transformation), contour was preserved but each interval size (magnitude) was reduced by half.
Results show that subjects' accuracy levels were highest when melodies were presented either in their original form or simply transferred an octave, approximately 81% and 78%, respectively; and while the other melodic transformations generated significantly fewer correct responses, accuracy levels were higher in LT conditions than in the PC and OVC transformations. Thus, the authors deduced that tone chroma alone is not sufficient for melodic recognition, and that specific interval successions, which, as a result, retain contour, provide essential information for melodic perception.

Earlier studies (e.g., Krumhansl, 1979; Krumhansl, Bharucha, & Kessler, 1982; Castellano, Bharucha, & Krumhansl, 1984) based on psychoacoustical and/or structural characteristics suggest that tonic identification is a result of perceived hierarchies, and furthermore, perception of tonal entities, such as chords, scale tones, and tonal sequences, are mere products of these tonal hierarchies.

Krumhansl (1979) suggests that if a tone simply belongs to a tonic triad it will be heard in a clear tonal context. No consideration is given to possible functions and relationships that tones may enter into in tonal music. In support of her theory, the author proposes that the dominant is nearly as stable as the tonic primarily because, besides the tonic, subjects rate the dominant higher than other members of the set in finality tests (e.g., Krumhansl & Shepard, 1979). It is important to note that the rules used to judge completeness of a melody are not the same as those requiring subjects to make tonality judgments. The
effect the dominant may have on one's perceiving it as a good ending tone may be contingent upon whether this dominant is positioned as the root of a dominant chord, the fifth of a tonic chord, or the third of a mediant chord, or one of the other numerous possibilities. Any suggestion that the last note in a tone sequence is prominent simply because of where it occurs is not applicable to real melodies heard in a tonal context.

In a subsequent study, Bharucha and Krumhansl (1983) tested the effects of tonal context on chord perception in formally trained and untrained subjects. In the first of two experiments, subjects rated a pair of chords in context (i.e., following a IV-V-I progression in either C or F# major) and in no context (i.e., presented in isolation). In the second experiment, subjects judged whether comparison chord progressions were the same or different. These progressions were either totally random or restricted to those typical of tonal music.

In general, results showed that both trained and untrained subjects rated chords from the tonal context as more stable and appropriate. A similarity of averages for correlations between the response accuracy levels for trained and untrained subjects was observed, .462 and .407, respectively, with both beyond the .05 level of significance. Tests requiring more sophisticated discriminative abilities for chord identification would probably generate a significant difference in accuracy levels between trained and untrained subjects. The authors observed that accuracy levels were highest when chord sequences
formed familiar tonal progressions rather than random chord successions. Therefore, they concluded that chord perception is indeed enhanced or repressed by the type of relationships formed between the perceived chords and the prevailing tonality.

Brown (1988) discovered that the temporal placement of particular intervals in music has a significant effect on tonality perception. By manipulating the order of pitches from musical excerpts, Brown was able to obtain predictable tonic-identification responses from subjects. The pitch strings were rearranged to (a) strongly imply the tonic, (b) evoke a different tonic, or (c) elicit a diversity of responses. Results show that when the rarest interval in the diatonic set (i.e., tritone) occurred near the end of the sequence, subjects' accuracy levels were highest (82.6%). Other placements of this interval within the string produced significantly lower accurate responses. The author suggests that the importance of these intervals to tonality perception does not rest in their mere presence but on their function, their ability to evoke a sense of tonality when placed strategically. While subjects in Brown's study were formally trained musicians, results from earlier studies (e.g., Butler, 1982; Panion, 1983) suggest that training plays a less important role in tonic identification than in other listening abilities.

Butler and Brown (1984) and Brown (1988) have warned against tonality perception studies that fail to consider the functionality and context of tone relationships germane to the construction of tonal
music: "...tonality is too complex a phenomenon to be explained in the time-independent terms of psychoacoustics or pitch-class collections, that perceived tonal relationships are too flexible to be forced into static structural representations,..."5

These studies shed significant light on the possibility of existing relationships among the abilities absolute pitch, relative pitch, tonic identification, chord identification and melodic perception. This review now considers published standardized tests of musical listening ability.

STANDARDIZED TESTS

A fair amount literature is available that summarizes and compares different standardized tests of musical ability (e.g., Radocy and Boyle, 1979; Shuter-Dyson and Gabriel, 1981; Deutsch, 1982). These studies are primarily devoted to comparing the validity and reliability levels among different tests. No study was found that seeks to determine whether relationships exist among different musical abilities. Furthermore, standardized studies that attempt to compare the effect(s) that formal training may have on possessing any combination of the abilities absolute pitch, relative pitch, tonic perception, chord perception and melodic perception are also nonexistent. This present

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5Brown, 1988, p. 219.
review considers only those standardized measures that test for one or more of the abilities measured in the present study.

As mentioned earlier, measuring the ability that subjects use in completing specific music listening tasks is difficult, if not impossible. In fact, many authors have labeled segments of their tests in one category when the ability needed to successfully complete the task, at least in part, may belong to another. For example, in the chord identification segment of the Associate Diploma Examinations in Music, published by The Board of Trinity College of Music in 1985, subjects are required to name specific modulations and cadences after being presented a tonic chord and short musical excerpts. This task would probably be classified more properly as a tonic identification test; nevertheless, under the given circumstances the possession of tonic and relative pitch identification abilities are unquestionably necessary. Taking into consideration this inherent problem, this review categorizes discussions accordingly.

While research literature on absolute pitch is abundant,\textsuperscript{6} this ability has not been included in standardized tests of musical ability, whether due to a problem of measuring this ability in typical testing environments or for other reasons.

The majority of tests classified under the heading of relative pitch do not require subjects to make specific interval discriminations. One

\textsuperscript{6}Rush (1989).
type from this category requires subjects to make simple higher versus lower judgments (e.g., Seashore 1919; Beach, 1930; McCreary, 1937; Conrad, 1940, Biondo, 1957; Bentley, 1966; Colwell, 1968; Bridges & Rechter, 1974; Rodgers, 1977). Little to no training is required in these examinations. Subjects typically must indicate whether subsequent tones are higher or lower than previous ones, or they are required to identify the highest or lowest pitch of a tone pattern. Another test from this classification measures subjects' ability to respond correctly when tones are lowered or raised (e.g., Seashore 1919; Gaston, 1957; Wing, 1961; Bentley, 1966; Colwell, 1968). Subjects are typically asked to respond "yes" or "no" that a tone has been altered, or they must identify the modified tone. Others have tested for subjects' ability to simply identify if a change in pitch height occurs (e.g., McCreary, 1937; Conn, 1955; Bridges & Rechter, 1974). In these measures subjects must identify whether a pitch is the same or different than a previously played one. Two tests were found that require subjects to identify skips and leaps out of a tone pattern (Colwell, 1968; Snyder Knuth, 1968) and one test was found that requires subjects to sing the first five notes of the major scale after hearing a tonic triad and to sing the highest tone heard in a root position major or minor triad (Rodgers, 1977).

Only a few of these tests, however, have required subjects to know and be able to discriminate specific intervallic relationships. One of these types require that subjects choose the correct interval from a list of possible answers (e.g., Aliferis, 1954; Poland, 1961; Aliferis &
Stecklein, 1962). Others range from having subjects circle the proper note written on a staff (e.g., Poland, 1979) to having subjects identify several consecutive tones played after the establishment of a key (e.g., Rodgers, 1977). One was found that require subjects to identify specific solfeggio syllable names (Beach, 1930).

The perception of tonality has been measured by several authors of standardized tests. The simplest of these tests merely require subjects to locate the tonic of a musical passage (e.g., Colwell, 1968; Snyder Knuth, 1968) or to indicate whether a compositional excerpt modulates (e.g., Drake, 1954). Another requests that subjects indicate whether a musical excerpt is tonal or nontonal (Gordon, 1971). The more advanced of these tests range from those that measure subjects' ability to identify specific cadences (e.g., Lowery, 1926; Colwell, 1968; Trinity College of Music, 1985) to those that require subjects to identify and name specific modulations heard (e.g., Associated Board of the Royal Schools of Music, 1985; Trinity College of Music, 1985). In the former of these two tests, subjects are presented musical excerpts that either modulate to the dominant, subdominant or relative key areas. Subjects are required to pinpoint the specific modulations. One test was found that requires subjects to produce their responses musically. In the tonic identification segment of the London College of Music Test: Specimen Ear Test (Rogers, 1977), subjects are allowed to either sing or hum the tonic of a short musical passage.
One of the most popular of chord identification tests measures subjects' ability to distinguish whether chord presentations are the same or different. These tests range from having subjects simply identify whether chords presented consecutively are the same or different (e.g., Hevner & Landsbury, 1935; McCreary, 1937; Whistler & Thorpe, 1950; Long, n. d.; Moyer, n. d.) to requiring subjects to indicate the point in a melody at which a chord changes, to only requiring that subjects count the number of chords heard in a sequence (e.g., Milwaukee Public Schools, 1966). Another type calls for subjects to make value judgments regarding the placement of certain chords in musical excerpts. These tests typically request subjects to judge the ability of certain chords to express mood (e.g., Hevner & Landsbury, 1935, Long, n. d.) or subjects are asked to rate how well a chord ends a particular musical passage (e.g., Lowery, 1926).

Fewer chord identification tests demand that subjects possess specific chord discrimination abilities. The chord identification test of the Examination for London Royal Schools of Music requests subjects to identify the tonic, dominant and subdominant chords in their proper inversions as they occur in chord progressions. Another category measures subjects' ability to identify chords used in

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Rodgers (1977) presents unaccompanied melodies up to the point of a cadence. Then selected chords are introduced in the accompaniment. Subjects must identify the specific chords used in the cadence. Others require subjects to identify isolated chords by either choosing from a list whether a triad’s quality is major, minor, diminished, or augmented (e.g., Poland, 1961; Rodgers, 1977) or by labeling chords as they occur in various inversion (e.g., Trinity College of Music, 1985).

Most published measures of musical abilities include tests that examine subjects’ melodic identification skill. The differences in these test designs are virtually as numerous as the number of tests in existence. One of the most common tasks simply tests subjects’ ability to differentiate whether two or more melodies are the same or different. This category of tests ranges from requiring subjects to compare melodies presented aurally (e.g., Kwalwasser & Dykema, 1930; Drake, 1954; Conn, 1955; Gaston, 1957; Gordon, 1971; Bridges & Rechter, 1974) to having subjects compare the similarities between aurally and visually presented melodies (e.g. McCready, 1937; Whistler and Thorpe, 1950). Similar tests have required that subjects indicate “yes” or “no” that changes have occurred between the first and second playing of melodies (e.g., Hevner, 1930, Long, n. d.).

These tests are also mentioned in the discussion of tonic identification; however, only their application as chord identification tests are reviewed here.
Another common melodic identification response task measures subjects’ ability to apprehend notated melodies. Some require that subjects choose the correct notation from a collection of alternatives for melodies presented aurally (e.g., Beach, 1930; Knuth, 1936; Farnum, 1953; Milwaukee Public Schools, 1966; Colwell, 1968; Snyder Knuth, 1968; Poland, 1979). Others place emphasis on subjects’ ability to identify seemingly familiar folk tunes or nursery rhymes (e.g., Mary Had A Little Lamb, On Top Of Old Smokey, etc.) under various conditions (e.g., Gildersleeve, 1933; McCauley, 1933; Cleveland Board of Education, 1929-1941; Kotick & Torgerson, 1950; Conn, 1955; Poland, 1979; Hutchinson, n. d.). These range from measures that call for subjects to compare aural presentations to collections of melodies notated to those where subjects must compare lists of titles to corresponding lists of notated melodies. Others involve tests where subjects must identify mistakes in familiar notated melodies (e.g., Gildersleeve, 1933; Conn, 1955; Poland, 1979). Comparisons on these tests are made between lists of titles and notated melodies or between melodies presented both aurally and notated. Finally, of the many tests discovered involving notation, only one of these requires melodic dictation (i.e., Gordon, 1971).

Few have measured subjects’ ability to identify melodic contour (e.g., Beach, 1930; Snyder Knuth, 1968; Poland, 1979). Subjects are usually asked to describe the direction and order at which melodies ascend and/or descend. A single test was found that requires subjects
to identify scale types (i.e., Poland, 1961). Likewise, only one test was encountered that requires subjects to identify particular melodies from among other musical stimuli (i.e., Colwell, 1968).

SUMMARY

A review of studies of the abilities of absolute pitch, relative pitch, tonic identification, chord identification and melodic identification has investigated published research and standardized measures of musical ability. The basis of this review was an inquiry concerning prior research that might have sought to show that relationships among certain, if not all, of these musical listening abilities do exist. Also, the possibility that formal training may play a significant role in the possession of these listening abilities and subsequent relationships was explored.

This review has shown that from reports on experimental research comes an enormous amount of literature on absolute pitch ability. Some have suggested that possessors of absolute pitch use an anchoring technique to facilitate the identification of pitches. Once a tone is heard, it is immediately compared to an internal reference tone stored in long-term memory. This would imply a type of partnership between the abilities absolute pitch and relative pitch. Others propose that absolute pitch is a product of chroma identification, i.e., that every tone has a characteristic that is
perceivable to possessors of absolute pitch. Other suggestions are offered as well. However, this review shows that while absolute pitch possessors may have an advantage above non-possessors on isolated pitch tasks, these advantages diminish in listening situations that resemble typical musical settings, especially when possessors of absolute pitch lack other music listening abilities. And furthermore, depending on the task at hand, these other abilities may play a more important role than absolute pitch.

Few reports consider the effects that other music listening abilities might have on relative pitch ability. An even smaller number reported subjects' ability to discriminate specific interval sizes, and intervals in these tests often had nothing to do with the equal tempered set with which musicians are experienced. Some have suggested that the use of intervals which are more easily attainable may aid in the perception of such musical constructs as melodies. Others, however, suggest that such attributes as specific interval sizes, frequently recurring intervals, or subjects' attentiveness to specific intervallic successions determines the level of perception.

Reports on tonic identification are even more scarce. The present review shows that one theory proposes that tonic identification is the result of one's perception of such structural elements as chords, scale tones or tone sequences. Little consideration here is given to how these elements operate in tonal music. Others have suggested, however, that mere membership in the tonal system is not enough to
ensure tonic perception; but only when these static structural elements are carefully positioned in music, can they influence one's perception of a tonal center.

In summary of the review of standardized tests, it is important to note that: (1) absolute pitch tests have not been included by any of these authors. It is conceivable that its omission is due to the difficulty of measuring this ability accurately in a typical testing environment, other reasons notwithstanding. (2) Tests for relative pitch ability are included in many standardized measures, but only a smaller portion of these examines subjects' ability to make definite interval size discriminations. Subjects are typically only required to make higher vs. lower, same vs. different or yes vs. no responses. (3) A smaller number have attempted to measure tonic identification ability. The simplest of these only require subjects to indicate whether a musical excerpt is tonal or nontonal. Others ask subjects to indicate whether or not a passage of music modulates. More sophisticated measures require subjects to name specific cadences and modulations. (4) Several have tested for chord identification ability. The most prevalent of these require that subjects make same vs. different judgments. Others range from requiring subjects to simply identify when chords change to more complicated measures that test subjects ability to identify chord qualities. (5) A vast number of standardized tests measure melodic perception skills. While many only require subjects to make same vs. different comparisons, a large number necessitate more sophisticated melodic identification abilities.
These range from having subjects compare aural presentations to printed scores, to requesting that subjects sight-sing with solfege syllables. Others include melodic dictation, mistake identification, and a few that allow subjects to play their responses on instruments of their choice.

The difficulty of controlling particular listening abilities that subjects use on perception tests was also discussed. Not only do subjects use different abilities than the ones called for by authors in completing specific tasks, but often times listening skills are combined to facilitate correct perception judgments. And to add to this confusion, often titles and subtitles used by experimenters are vague and misrepresentative, leading one to believe that a particular ability is being measured when in fact it is another that is being tested.

Finally, few correlational studies were found, none that attempt to show relationships among the music listening abilities investigated in the present study. The majority of existing comparative studies only summarize and rate the validity and reliability levels of existing standardized tests.
CHAPTER III

PROCEDURES

Chapter II reviewed literature on published research and standardized tests of the music listening abilities of absolute pitch, relative pitch, tonic identification, chord identification and melodic identification. This chapter describes subjects, testing instruments and testing procedures in the present study.

SUBJECTS

All subjects volunteered but had to meet the requirements of one of the groups described below. Group one was composed of thirty-eight formally trained musicians from the Ohio State University and the University of Alabama at Birmingham. Academic backgrounds ranged from sophomore to graduate student; and all, except for the sophomores, had successfully completed the theory and ear training series at their respective institutions. The sophomores were presently enrolled in their final year of music theory and ear-training as required by both institutions. Their major instruments included voice, piano, winds, strings and percussion.
The other group of subjects, which numbered thirty-five, was composed of musicians with no formal training in music. These subjects had experience performing gospel and/or popular music and were currently members of either a choir, ensemble or band in Columbus, Ohio and Birmingham, Alabama. Their performance mediums included voice, piano, winds and percussion.

APPARATUS

Stimulus tones and patterns needed for the music listening tests were piano tones reproduced by Yamaha TX81Z & TX7 FM tone generators. The Apple Macintosh Plus computer and Mark of the Unicorn's Performer software were used to sequence stimuli. These instruments were used to ensure consistent tempi, rhythms and velocity levels. Musical excerpts were tape recordings of various 18th, 19th and 20th century tonal compositions. An Akai model C5-F12 cassette recorder was used to record these excerpts. JVC model PC-200 and Nakamichi model 480 cassette recorders, routed through a Sony model MX-P21 mixer and Carver model PM-175 amplifier to Electro-Voice model Sentry 100-A speakers were used to present

1Sequencing denotes recording digital information sent from music synthesizers or samplers via MIDI (Musical Instrument Digital Interface).
stimuli. Responses were recorded on JVC model PC-200 and Panasonic model RX-5090 tape recorders.

METHOD

The test was divided into two parts, a recognition segment and a production segment. Each segment was composed of five different ability measures: absolute pitch, relative pitch, tonic identification, chord identification and melodic identification. Both trained and untrained musicians had to complete each segment of the recognition and production tasks.

Because the untrained musicians were not expected to perform as well on tasks requiring prior understanding of a labeling system, a pretest session was held to familiarize these subjects with the procedures needed to perform the various tasks. For the absolute pitch segment, the system of sharps and flats was discussed. The untrained musicians were already familiar with pitch letter names. For relative pitch, interval names and relationships were introduced. For tonic identification, the relationship of the tonic in the tonal system was explained. For melodic identification, the principles of notation were introduced.

Most ability segments comprised ten test items. However, because of the design of the absolute pitch and melodic identification tests, raw scores of subjects' responses on these ability segments were
converted to prevent experimental-wise error when analyzing and comparing data across all ability tests.

In the absolute pitch tests, subjects were not simply graded on their number of correct responses, but on an average error in semitone distance from the target tone. Information theory statistics were then used to measure the amount of transmission necessary for the 12 tones of the equal-tempered musical scale. Assuming subjects would perceive perfectly the 12 tones of the scale, the amount of information conveyed would be 3.585 bits, i.e., $\log_2 (12) = 3.585$ bits.\(^2\) Subjects' scores varied accordingly and were then converted as described above. This procedure was considered a more accurate method of measuring absolute pitch ability. For example, it is conceivable that an individual who is consistently off by a semitone in pitch labelling should not be penalized to the same degree as an individual whose errors are sporadic and show little or no degree of pitch perception ability. Tests that only measure the number of correct responses made on an absolute pitch discrimination task fail to account for this problem.

Converting responses on the melodic production task were simple. A total of twenty notes were presented. The number of correct notes each subject notated were then divided by two, making the total number of possible correct responses ten.

\(^2\)See Carroll (1975) and Rush (1989) for a complete discussion of this principle.
RECOGNITION TEST

The absolute pitch segment was administered first. Each tone of the chromatic scale was presented in random order and octave. After each hearing, subjects were allowed three seconds to write the name of the tone heard on an answer sheet before hearing the next tone.

On the relative pitch recognition task, subjects heard ten pairs of either harmonic, melodic ascending or melodic descending intervals. They were then asked to circle the correct interval name from a given list. Intervals ranged from a perfect prime to a perfect octave. Compound intervals were excluded from either of the relative pitch tasks.

The third task measured for tonic recognition ability. Subjects were presented short excerpts of major or minor tonal compositions. These works were examples from the 18th, 19th and 20th century and styles ranged from classical to jazz, from gospel to top 40. Each excerpt lasted under one minute and strengths of harmonic cadences varied. After hearing each of ten excerpts subjects heard a tone and were asked to indicate whether the tone they heard matched the tonic of the musical excerpt.

On the chord recognition task, subjects heard a total of ten triads and seventh chords. Each chord presentation was played twice, both times arpeggiated and blocked. After each presentation, subjects were
asked to identify the quality of the chord by circling the correct chord name from a given list.

The last part of this segment measured for melodic recognition ability. Subjects were presented ten original melodies. Figure 1 shows an example of the melodies used in this task.

![Figure 1. Example from the melody recognition test.](image)

On each presentation subjects chose the correct melody heard from a group of three melodies notated on their answer sheets. The contours of counterfeit melodies maintained the direction of the correct melody to prohibit responses based on contour alone. After each presentation subjects were asked to mark an “X” besides the correct melody. Each melody was played three times.

---

3A copy of the complete test is displayed in Appendix C.
PRODUCTION TEST

On the absolute pitch production test, subjects were asked to sing, whistle or hum each of the 12 tones of the chromatic scale. Tones were requested in random order and subjects could reproduce tones in their most comfortable register. Each response was recorded on tape and graded.\(^4\)

The relative pitch segment requested subjects to sing, whistle or hum a specified interval above or below a stimulus tone. Tones were tripled in different octaves to reduce possible register effects and subjects were allowed to produce responses in their most comfortable octave register. Each tone was presented twice prior to subjects' responses. Then their responses were recorded on tape and graded.

On the tonic production test, subjects were again presented excerpts of major or minor tonal compositions from the 18th, 19th and 20th century. As on the recognition test, styles ranged from classical to popular and the complexity of harmony varied across these examples. After each hearing, subjects were once more requested to sing, whistle or hum the tone representative of the tonal center. Choice of the most comfortable octave register was allowed. Responses were again tape recorded and graded.

\(^4\)All taped responses were graded by the author and double-checked by Dr. David Butler, Director of the Music Perception Studio at Ohio State and dissertation adviser.
The chord production test required subjects to sing, whistle or hum members of various triads and seventh chords from their roots up to their highest members. Each root was sounded twice before subjects made their responses. Subjects were allowed to produce responses in their most comfortable register, and these were recorded on tape and graded.

For the melodic production task, subjects were presented two original melodies, shown in Figure 2.

![Figure 2. Original melodies used in the melodic production test.](image)

Each melody was essentially scalar, with skips limited to members of the tonic or dominant chord. Subjects were provided the clef, key signature, time signature and first note of each melody. Upon hearing each melody, subjects were instructed to notate the melodies they heard. Each melody was preceded by an appropriate number of clicks to establish meter and tempo and was presented four times. Responses were graded on pitch notation only.
CHAPTER IV

RESULTS

Data collected for this study was subjected to four statistical procedures. T-tests were used to measure whether differences in mean scores between both groups of musicians were significant in both the recognition and production segments. Two-way analyses of variance were used to measure interaction effects among the ability measures on the recognition, production and combined response tasks between the formally and informally trained musicians. Multiple regression analyses were used to identify relationships between each ability and the combination of other abilities, plus musicians' training level. This analysis showed results with response tasks separated and combined. Finally, correlation coefficients tested for simple relationships between paired music listening abilities in the formally trained, the informally trained, and the combined group of musicians.
Table 1 shows $t$ tests for trained and untrained musicians on each of the music recognition response tasks: absolute pitch, relative pitch, tonic identification, chord identification and melodic identification.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Trained Mean</th>
<th>Untrained Mean</th>
<th>Unpaired t Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP</td>
<td>3.142</td>
<td>3.059</td>
<td>.281</td>
</tr>
<tr>
<td>RP</td>
<td>7.342</td>
<td>1.6</td>
<td>12.277 **</td>
</tr>
<tr>
<td>TI</td>
<td>7.342</td>
<td>5.971</td>
<td>3.422 **</td>
</tr>
<tr>
<td>CI</td>
<td>7.789</td>
<td>1.686</td>
<td>13.314 **</td>
</tr>
<tr>
<td>MI</td>
<td>9.143</td>
<td>3.806</td>
<td>12.245 **</td>
</tr>
</tbody>
</table>

Bonferroni's corrections for experimental-wise error were calculated on the predetermined probability level ($p \leq .05$). This procedure revealed that a significance level of .01 was necessary in comparing means between groups on the five music recognition tasks shown in Table 1. Results show that differences in means were statistically significant on all recognition variables except absolute pitch. Besides absolute pitch recognition, the formally trained musicians performed better on each of these tasks. Results also show that the largest statistically significant variance occurred in chord recognition ($t = 13.314$) and the smallest occurred in tonic recognition ($t = 3.422$). The statistic eta square was used to assess the
practical significance or meaningfulness of the differences discovered. A magnitude of .14 was found for differences in training on tonic recognition. This indicates that although the difference between training was statistically significant on this measure, this finding has relatively little practical significance. Close observation reveals that the informally trained musicians performed better on tonic recognition than any other recognition listening task. Magnitude levels of eta square on the other statistically significant findings were well beyond the accepted level of .15. The trained musicians performed best on the melodic recognition task.

Table 2 shows t tests for trained and untrained musicians on each of the music production response tasks: absolute pitch, relative pitch, tonic identification, chord identification and melodic identification.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Trained Mean</th>
<th>Untrained Mean</th>
<th>Unpaired t Value:</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP</td>
<td>4.377</td>
<td>2.768</td>
<td>3.767 **</td>
</tr>
<tr>
<td>RP</td>
<td>6.684</td>
<td>2.029</td>
<td>8.599 **</td>
</tr>
<tr>
<td>TI</td>
<td>6.079</td>
<td>3.571</td>
<td>4.606 **</td>
</tr>
<tr>
<td>CI</td>
<td>6.5</td>
<td>6.57</td>
<td>11.833 **</td>
</tr>
<tr>
<td>MI</td>
<td>8.039</td>
<td>2.086</td>
<td>10.654 **</td>
</tr>
</tbody>
</table>

** p < .01
Once more, Bonferroni's corrections for experimental-wise error were calculated on the predetermined probability level (p ≤ .05). The significance level .01 was considered appropriate in comparing means between the trained and untrained subjects on the five music production tasks shown in Table 2. Results show that differences in means were statistically significant on all production variables. Eta square statistics confirmed that these differences were practically significant as well. The formally trained musicians performed better on each of these tasks. Furthermore, results show that the largest significant variance occurred in chord production (t = 11.833) and the smallest occurred in absolute pitch production (t = 3.767). As in the recognition response tasks, the informally trained musicians performed best on tonic production and the formally trained performed best on melodic production.

Hypothesis 1 stated that mean scores of trained subjects would be significantly higher than mean scores of untrained subjects on tests of absolute pitch. Results show that differences between subjects' performance on these tests are only significant on the production response task. The untrained musicians performed as well as the trained musicians on the test for absolute pitch recognition. Therefore, hypothesis 1 can only be accepted for absolute pitch production.

Hypothesis 2 stated that mean scores of trained subjects would be significantly higher than mean scores on untrained subjects on tests of
relative pitch. Results show that the trained musicians performance levels were significantly higher than those of the untrained musicians on both relative pitch recognition and production. Therefore, hypothesis 2 is accepted.

Hypothesis 3 stated that mean scores of trained subjects would be significantly higher than mean scores of untrained subjects on tests of tonic identification. While the difference between mean scores of the trained and untrained musicians were statistically significant on both tonic identification response tasks, tests for practical significance failed to established a meaningfulness between mean score differences on tonic recognition. Therefore, hypothesis 3 can only be accepted for tonic production.

Hypothesis 4 stated that mean scores of trained subjects would be significantly higher than mean scores of untrained subjects on tests of chord identification. Results indicated that the trained musicians' performance levels were significantly higher than those of the untrained musicians on both chord identification response tasks. Therefore, hypothesis 4 is accepted.

Hypothesis 5 stated that mean scores of trained subjects would be significantly higher than mean scores of untrained subjects on tests of melodic identification. Results show significantly higher mean scores for the trained musicians on both melodic identification response tasks. Therefore, hypothesis 5 is accepted.
Table 3 shows a two-way analysis of variance and mean scores for recognition tests between formally and informally trained subjects.

### TABLE 3

Two-Way Analysis of Variance and Mean Scores for Recognition Tests Between Formally and Informally Trained Subjects

<table>
<thead>
<tr>
<th>Source</th>
<th>DF:</th>
<th>Sum Squares:</th>
<th>Mean Square:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subgroups</td>
<td>9</td>
<td>2489.893</td>
<td>276.655</td>
</tr>
<tr>
<td>A</td>
<td>4</td>
<td>657.066</td>
<td>164.266</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>1265.605</td>
<td>1265.605</td>
</tr>
<tr>
<td>A x B</td>
<td>4</td>
<td>567.223</td>
<td>141.806</td>
</tr>
<tr>
<td>Error</td>
<td>355</td>
<td>1120.544</td>
<td>3.156</td>
</tr>
<tr>
<td>Total</td>
<td>364</td>
<td>3610.437</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>F-test</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>52.041</td>
<td>p ≤ .0001</td>
</tr>
<tr>
<td>B</td>
<td>400.957</td>
<td>p ≤ .0001</td>
</tr>
<tr>
<td>A x B</td>
<td>44.926</td>
<td>p ≤ .0001</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cell Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>RP Rec</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

Group 1 = Informally Trained & Group 2 = Formally Trained

Results show that differences among the music recognition ability measures produced an $F$ value of 52.04 ($p < .05$).\(^1\) Also, in measuring the differences between the trained and untrained musicians on these abilities an $F$ value of 400.96 ($p < .05$) resulted. The differences in the relative effect of training on these abilities were significant as well.

\(^1\)The chosen statistical package reports the highest level of significance achieved. However, ($p < .05$) is the level of acceptance for the present study.
The test for interaction generated an $F$ value of 44.93 ($p < .05$). Figure 3 displays the interaction effect reported in Table 3.

![Graph of interaction effects between training and the music recognition tasks.](image)

**Figure 3.** Graph of interaction effects between training and the music recognition tasks.

Results displayed in Figure 3 show that differences among the music recognition ability measures were not constant between groups. Departure from a parallel relationship is most obvious in tonic identification (TI) and absolute pitch (AP). In other words, training was less a factor in possessing these skills than in any of the recognition abilities. Furthermore, results show no difference in response accuracy on absolute pitch recognition between the trained and untrained musicians.
Table 4 shows a two-way analysis of variance and mean scores for production tests between formally and informally trained subjects.

TABLE 4
Two-Way Analysis of Variance
and Mean Scores for Production Tests Between
Formally and Informally Trained Subjects
A: Five Production Responses  B: Training

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Sum Squares</th>
<th>Mean Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subgroups</td>
<td>9</td>
<td>1967.886</td>
<td>218.654</td>
</tr>
<tr>
<td>A</td>
<td>4</td>
<td>143.377</td>
<td>35.844</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>1541.821</td>
<td>1541.821</td>
</tr>
<tr>
<td>A x B</td>
<td>4</td>
<td>282.687</td>
<td>70.672</td>
</tr>
<tr>
<td>Error</td>
<td>355</td>
<td>1718.214</td>
<td>4.84</td>
</tr>
<tr>
<td>Total</td>
<td>364</td>
<td>3686.1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>F-test</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>7.406</td>
<td>p ≤ .0001</td>
</tr>
<tr>
<td>B</td>
<td>318.555</td>
<td>p ≤ .0001</td>
</tr>
<tr>
<td>A x B</td>
<td>14.601</td>
<td>p ≤ .0001</td>
</tr>
</tbody>
</table>

Cell Means

<table>
<thead>
<tr>
<th>Cell Means</th>
<th>RP Pro</th>
<th>TI Pro</th>
<th>CI Pro</th>
<th>MI Pro</th>
<th>AP Pro</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.029</td>
<td>3.571</td>
<td>.657</td>
<td>2.086</td>
<td>2.766</td>
</tr>
<tr>
<td>2</td>
<td>6.684</td>
<td>6.079</td>
<td>6.5</td>
<td>8.039</td>
<td>4.377</td>
</tr>
</tbody>
</table>

Group 1 = Informally Trained & Group 2 = Formally Trained

Results show that differences among music production ability levels yielded an F value of 7.41 (p < .05). The differences between the trained and untrained subjects on these measures resulted in an F value of 318.56 (p < .05). Finally, the test for interaction differences among these means between the trained and untrained musicians shows a significant F value of 14.60 (p < .05). These interaction effects are shown in Figure 4.
Figure 4. Graph of interaction effects between training and the music production tasks.

Figure 4 shows that departure from the parallel model is evident. Mean differences among the music production ability measures fluctuated between training. As in the recognition test, training was less a factor in the possession of absolute pitch and tonic identification than any of the other music production listening tasks.
Table 5 shows a two-way analysis of variance and mean scores for combined ability response tasks between the formally and informally trained subjects.

**TABLE 5**

**Two-Way Analysis of Variance and Mean Scores for Combined Ability Responses Tasks Between the Formally and Informally Trained Subjects**

A: Five Ability Measures with Response Tasks Combined  
B: Training

<table>
<thead>
<tr>
<th>Source</th>
<th>DF:</th>
<th>Sum Squares:</th>
<th>Mean Square:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subgroups</td>
<td>9</td>
<td>2138.47</td>
<td>237.608</td>
</tr>
<tr>
<td>A</td>
<td>4</td>
<td>333.732</td>
<td>83.433</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>1400.308</td>
<td>1400.308</td>
</tr>
<tr>
<td>A x B</td>
<td>4</td>
<td>404.43</td>
<td>101.107</td>
</tr>
<tr>
<td>Error</td>
<td>355</td>
<td>1060.473</td>
<td>2.987</td>
</tr>
<tr>
<td>Total</td>
<td>364</td>
<td>3198.943</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>F-test</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>27.93</td>
<td>( p \leq .0001 )</td>
</tr>
<tr>
<td>B</td>
<td>468.762</td>
<td>( p \leq .0001 )</td>
</tr>
<tr>
<td>A x B</td>
<td>33.846</td>
<td>( p \leq .0001 )</td>
</tr>
</tbody>
</table>

**Cell Means**

<table>
<thead>
<tr>
<th>AP</th>
<th>FP</th>
<th>TI</th>
<th>CI</th>
<th>MI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.913</td>
<td>1.814</td>
<td>4.771</td>
<td>1.171</td>
</tr>
<tr>
<td>2</td>
<td>3.759</td>
<td>7.013</td>
<td>6.711</td>
<td>7.145</td>
</tr>
</tbody>
</table>

Group 1 = Informally Trained & Group 2 = Formally Trained

Mean differences among music ability measures with combined response tasks generated an \( F \) value of 27.93 (\( p < .05 \)). An \( F \) value of 468.76 (\( p < .05 \)) resulted from mean differences between the trained and untrained musicians on the measures. And finally, the test for interaction between training level and the music listening tests
produced a significant $F$ value of 33.85 ($p < .05$). Interaction effects are displayed in Figure 5.

Results shown in Figure 5 reflect those discovered in Figures 3 and 4. The absence of parallel lines illustrates the effect of training on the possession of these listening skills. Formal training played a less important role on the possession of absolute pitch and tonic identification than on relative pitch, chord identification and melodic perception. Furthermore, it is suspected that the difference in mean score on the absolute pitch production task can be attributed to the formally trained musicians' ability to incorporate relative pitch skills in completing this task. The design of the absolute pitch recognition
test, prohibited more the interaction of other listening skills. Subjects had three seconds to write their responses before hearing another tone. Also, tone presentations were in varying octave registers. However, because subjects produced there responses vocally and were allowed to chose any comfortable octave register, implementation of this constraint was not possible on the absolute pitch production task.

Hypothesis 6 stated that relative differences among tests of music identification would not be the same between trained and untrained musicians. Analysis of interaction effects between training and the music identification skills reveals that training played a less important role in the possession of absolute pitch and tonic identification abilities than in relative pitch, chord identification and melodic identification abilities. These findings were consistent throughout measures for recognition and production response tasks, as well as when response tasks were combined. Therefore, hypothesis 6 is accepted.
Table 6 shows the results of a multiple regression analysis of absolute pitch recognition to the remaining recognition response tasks and training.

**TABLE 6**

**Multiple Regression Analysis of Absolute Pitch Recognition to Remaining Recognition Tasks and Training**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Std. Err.</th>
<th>T-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>3.311</td>
<td>.591</td>
<td>5.6</td>
</tr>
<tr>
<td>RP</td>
<td>.212</td>
<td>.101</td>
<td>2.104</td>
</tr>
<tr>
<td>TI</td>
<td>-.041</td>
<td>.093</td>
<td>-.443</td>
</tr>
<tr>
<td>CI</td>
<td>-.089</td>
<td>.098</td>
<td>-.906</td>
</tr>
<tr>
<td>MI</td>
<td>-.051</td>
<td>.097</td>
<td>-.53</td>
</tr>
<tr>
<td>Training</td>
<td>-.273</td>
<td>.622</td>
<td>-.438</td>
</tr>
</tbody>
</table>

Results show that the obtained $F$ value of .92 is not significant at the .05 level. There is insufficient evidence to suggest that there exists a linear relationship between absolute pitch recognition and any of the other recognition abilities. Results show that only 6% of the variation in absolute pitch recognition can be explained by the remaining variables.
Table 7 shows the results of a multiple regression analysis of absolute pitch production to the remaining production response tasks, i.e., relative pitch, tonic identification, chord identification and melodic identification, and training.

**TABLE 7**

*Multiple Regression Analysis of Absolute Pitch Production to Remaining Production Tasks and Training*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Std. Err.</th>
<th>T-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>2.282</td>
<td>.516</td>
<td>4.422</td>
</tr>
<tr>
<td>RP</td>
<td>.087</td>
<td>.128</td>
<td>.678</td>
</tr>
<tr>
<td>TI</td>
<td>.117</td>
<td>.114</td>
<td>1.026</td>
</tr>
<tr>
<td>CI</td>
<td>.054</td>
<td>.152</td>
<td>.358</td>
</tr>
<tr>
<td>MI</td>
<td>-.07</td>
<td>.117</td>
<td>-.596</td>
</tr>
<tr>
<td>Training</td>
<td>1.011</td>
<td>.794</td>
<td>1.272</td>
</tr>
</tbody>
</table>

Results show that the regression analysis of the overall test generated an $F$ value of 3.54 ($p < .05$). This finding suggest that at least one of the individual coefficients is different from zero. Observation of the beta coefficients in Table 7 show that the training variable has a regression coefficient of 1.01. However, results from the partial $t$ test show that this coefficient does not reduce the estimated standard error significantly beyond that of the model. The
partial test generated a $t$ of 1.272, which was not significant at the .05 level. Therefore, the hypothesis that there exists a linear relationship between absolute pitch production and any of the other production abilities is not substantiated. Only 21% of the variation in absolute pitch production can be explained by these variables.
Table 8 shows the results of a multiple regression analysis of absolute pitch with results from both response tasks combined. This variable is measured against the remaining listening abilities with results from their response tasks combined. The effect of training is tested as well.

**TABLE 8**

Multiple Regression Analysis of Combined Response Tasks of Absolute Pitch to Remaining Ability Measures with Response Tasks Combined and Training

<table>
<thead>
<tr>
<th>Multiple - Y: AP Combined</th>
<th>Five X Variables</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Source</th>
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<th>Mean Square:</th>
<th>F-test:</th>
</tr>
</thead>
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<tr>
<td>REGRESSION</td>
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<td>4.248</td>
<td>3.185</td>
</tr>
<tr>
<td>RESIDUAL</td>
<td>67</td>
<td>89.351</td>
<td>1.334</td>
<td>.01 &lt; p ≤ .025</td>
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<tr>
<td>TOTAL</td>
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<td>110.591</td>
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</tbody>
</table>

**Beta Coefficient Table**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value:</th>
<th>Std. Err.:</th>
<th>T-Value:</th>
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</thead>
<tbody>
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<td>.469</td>
<td>5.468</td>
</tr>
<tr>
<td>RP</td>
<td>.242</td>
<td>.11</td>
<td>2.203 *</td>
</tr>
<tr>
<td>TI</td>
<td>.058</td>
<td>.101</td>
<td>.58</td>
</tr>
<tr>
<td>CI</td>
<td>-.075</td>
<td>.117</td>
<td>-.642</td>
</tr>
<tr>
<td>MI</td>
<td>-.096</td>
<td>.107</td>
<td>-.903</td>
</tr>
<tr>
<td>Training</td>
<td>.466</td>
<td>.567</td>
<td>.822</td>
</tr>
</tbody>
</table>

*p < .05

Results from the regression produced an overall $F$ value of 3.19 ($p < .05$), indicating that at least one of the independent variable's coefficients does not equal zero. Beta coefficients in Table 8 show that
the regression coefficient for relative pitch is .64. Further observations reveal that the amount that this variable reduces the estimated standard error is statistically significant. The partial test generated a $t$ value of 2.203 ($p < .05$). However, since only 19% of the variation in absolute pitch is explained by the combined independent variables, there is insufficient evidence to assert that a linear relationship exists between absolute pitch and relative pitch, tonic identification, chord identification, melodic identification and training.

Hypothesis 7 stated that variation in absolute pitch ability would not be accounted for by performance on tests of relative pitch, tonic identification, chord identification and melodic identification, and training. Overall, results show that only 19% of the variation in absolute pitch was explained by these abilities. This finding was consistent with results from comparisons of absolute pitch to production response tasks and training level. Twenty-one percent of performance variance was accounted for under this condition. This percentage diminished considerably for comparisons to absolute pitch recognition. Only 6% of its performance variance was explained by the other recognition tasks and training. Therefore, based on these observations, hypothesis 7 is accepted.
Table 9 shows the results of a multiple regression analysis of relative pitch recognition to all other recognition response tasks and training.

**TABLE 9**

**Multiple Regression Analysis of Relative Pitch Recognition to Remaining Recognition Response Tasks and Training**

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Sum Squares:</th>
<th>Mean Square:</th>
<th>F-test:</th>
</tr>
</thead>
<tbody>
<tr>
<td>REGRESSION</td>
<td>5</td>
<td>732.149</td>
<td>146.43</td>
<td>67.724</td>
</tr>
<tr>
<td>RESIDUAL</td>
<td>67</td>
<td>144.865</td>
<td>2.162</td>
<td>p ≤ .0001</td>
</tr>
<tr>
<td>TOTAL</td>
<td>72</td>
<td>877.014</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Beta Coefficient Table**

<table>
<thead>
<tr>
<th>Parameter:</th>
<th>Value:</th>
<th>Std. Err.:</th>
<th>T-Value:</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>-.1431</td>
<td>.822</td>
<td>-1.742</td>
</tr>
<tr>
<td>AP</td>
<td>.292</td>
<td>.139</td>
<td>2.104 *</td>
</tr>
<tr>
<td>TI</td>
<td>.075</td>
<td>.109</td>
<td>.69</td>
</tr>
<tr>
<td>CI</td>
<td>.458</td>
<td>.101</td>
<td>4.516 *</td>
</tr>
<tr>
<td>MI</td>
<td>.241</td>
<td>.11</td>
<td>2.196 *</td>
</tr>
<tr>
<td>Training</td>
<td>1.586</td>
<td>.704</td>
<td>2.253 *</td>
</tr>
</tbody>
</table>

*p < .05

Results of the regression analysis generated an $F$ value of 67.72. This value was significant beyond the chosen probability level ($p < .05$), suggesting that at least one of the coefficients for the independent variables does not equal zero. Observation of partial $t$ tests indicates that all of the independent recognition variables except tonic identification were significant in reducing the error sum of
squares. Of these variables, chord identification was most significant. The $t$ value for this variable was $4.516 \ (p < .05)$. Absolute pitch accounted for the least variation in performance on this ability. Its $t$ significance was $2.104 \ (p < .05)$. There is strong evidence to suggest that a linear relationship exists between relative pitch recognition and the music listening abilities chord recognition, melodic recognition, absolute pitch recognition and training. Eighty-four percent of the variation in relative pitch recognition can be explained by these variables.
Table 10 shows the results of a multiple regression analysis of relative pitch production to all other production response tasks and training.

**TABLE 10**

*Multiple Regression Analysis of Relative Pitch Production to Remaining Production Response Tasks and Training*

<table>
<thead>
<tr>
<th>DF:</th>
<th>R-squared:</th>
<th>Std. Err.:</th>
<th>Coef. Var.:</th>
</tr>
</thead>
<tbody>
<tr>
<td>72</td>
<td>.738</td>
<td>1.738</td>
<td>39.046</td>
</tr>
</tbody>
</table>

**Analysis of Variance Table**

<table>
<thead>
<tr>
<th>Source</th>
<th>DF:</th>
<th>Sum Squares:</th>
<th>Mean Square:</th>
<th>F-test:</th>
</tr>
</thead>
<tbody>
<tr>
<td>REGRESSION</td>
<td>5</td>
<td>571.613</td>
<td>114.323</td>
<td>37.831</td>
</tr>
<tr>
<td>RESIDUAL</td>
<td>67</td>
<td>202.469</td>
<td>3.022</td>
<td>p &lt; .0001</td>
</tr>
<tr>
<td>TOTAL</td>
<td>72</td>
<td>774.082</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Beta Coefficient Table**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value:</th>
<th>Std. Err.:</th>
<th>T-Value:</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>.749</td>
<td>.55</td>
<td>1.362</td>
</tr>
<tr>
<td>AP</td>
<td>.078</td>
<td>.116</td>
<td>.678</td>
</tr>
<tr>
<td>TI</td>
<td>.029</td>
<td>.109</td>
<td>.268</td>
</tr>
<tr>
<td>CI</td>
<td>.452</td>
<td>.134</td>
<td>3.383*</td>
</tr>
<tr>
<td>MI</td>
<td>.317</td>
<td>.105</td>
<td>3.023*</td>
</tr>
<tr>
<td>Training</td>
<td>-.076</td>
<td>.764</td>
<td>-.099</td>
</tr>
</tbody>
</table>

* p < .05

An overall F value of 37.83 (p < .05) resulted from this regression analysis. Therefore, an analysis of the individual beta coefficients is warranted. Observation of partial t tests shows that the variables chord and melodic production were significant in reducing the error sum of squares. This test of significance generated t values of 3.383 and 3.023, respectively. Both variables were significant beyond the .05
level. This evidence suggests that a linear relationship exists between relative pitch production and chord and melodic production. Seventy-four percent of the variation in relative pitch production can be explained by these variables.

Table 11 shows results of a multiple regression analysis of relative pitch with results from both response tasks combined. This variable is measured against the remaining listening abilities with results from their response tasks combined and training.

<table>
<thead>
<tr>
<th>TABLE 11</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multiple Regression Analysis of Combined Response Tasks</strong></td>
</tr>
<tr>
<td>of Relative Pitch to Remaining Ability Measures</td>
</tr>
<tr>
<td>with Response Tasks Combined and Training</td>
</tr>
<tr>
<td><strong>Multiple - Y: RP Combined</strong></td>
</tr>
<tr>
<td>DF:</td>
</tr>
<tr>
<td>72</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Analysis of Variance Table</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Source</strong></td>
</tr>
<tr>
<td>REGRESSION</td>
</tr>
<tr>
<td>RESIDUAL</td>
</tr>
<tr>
<td>TOTAL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Beta Coefficient Table</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parameter</strong></td>
</tr>
<tr>
<td>INTERCEPT</td>
</tr>
<tr>
<td>AP</td>
</tr>
<tr>
<td>TI</td>
</tr>
<tr>
<td>CI</td>
</tr>
<tr>
<td>MI</td>
</tr>
<tr>
<td>Training</td>
</tr>
</tbody>
</table>

* p < .05
Results show an overall F value of 86.16, which was significant beyond the set probability level ($p < .05$). These findings indicate that one or more of the beta coefficients of the independent variables does not equal zero. Inspection of the partial t tests reveal that the independent variables chord identification, melodic identification and absolute pitch were significant in reducing the error sum of squares. Of these significant variables, chord identification accounted for the most variation in relative pitch. Its t value was 4.533 ($p < .05$). Melodic identification followed with a t value of 3.792 ($p < .05$). Absolute pitch accounted for the least variation in relative pitch. It generated a t value of 2.203 ($p < .05$). The evidence suggests that a linear relationship exists between relative pitch and chord identification, melodic identification and absolute pitch abilities, because 87% of the variation on the relative pitch tests can be accounted for by these listening skills.

Hypothesis 8 stated that variation in relative pitch ability would be accounted for by performance on tests of chord and melodic identification, and training. Overall, results show that 87% of the variation in relative pitch could be accounted for. In addition to the significant contributions of chord and melodic identification abilities, absolute pitch contributed to this relationship also, though accounting for the least amount of variation in relative pitch. Chord identification contributed most to this relationship. Results varied slightly for comparisons on each response task. Absolute pitch was not a
significant factor in the production model and the significance of training was limited to the recognition condition only. Therefore, hypothesis 8 is accepted totally for chord and melodic identification, and only in part for training.

Table 12 shows the results of a multiple regression analysis of tonic recognition to all other recognition response tasks and training.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Std. Err.</th>
<th>T-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>5.154</td>
<td>.695</td>
<td>7.417</td>
</tr>
<tr>
<td>AP</td>
<td>-.071</td>
<td>.16</td>
<td>-.443</td>
</tr>
<tr>
<td>RP</td>
<td>.094</td>
<td>.136</td>
<td>.69</td>
</tr>
<tr>
<td>Cl</td>
<td>.023</td>
<td>.129</td>
<td>.174</td>
</tr>
<tr>
<td>Mi</td>
<td>.222</td>
<td>.124</td>
<td>1.794</td>
</tr>
<tr>
<td>Training</td>
<td>-.441</td>
<td>.813</td>
<td>-.543</td>
</tr>
</tbody>
</table>

Results show that the regression of the overall test generated an $F$ value of 4.34 ($p < .05$) which implies that one or more of the independent variables has a coefficient different from zero. Examination of the beta coefficients in Table 12 shows a coefficient of
.22 for melodic recognition. However, results from the partial $t$ test show that this variable's contribution to $r^2$ was not significant. The $t$ of 1.794 for melodic recognition did not reach the chosen probability level of .05 and failed to reduce the estimated standard error significantly beyond that of the model. Thus, the hypothesis that there is a linear relationship between tonic recognition and the other recognition abilities is not substantiated. Only 25% of the variation in tonic recognition can be explained by these variables.

Table 13 shows the results of a multiple regression analysis of tonic production to all other production response tasks and training.

**TABLE 13**

**Multiple Regression Analysis of Tonic Production to Remaining Production Response Tasks and Training**

<table>
<thead>
<tr>
<th>Multiple - Y: Tonic Production</th>
<th>Five X Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>DF:</td>
<td>R-squared:</td>
</tr>
<tr>
<td>72</td>
<td>.491</td>
</tr>
<tr>
<td>Std. Err.:</td>
<td>1.944</td>
</tr>
<tr>
<td>Coef. Var.:</td>
<td>39.868</td>
</tr>
</tbody>
</table>

**Analysis of Variance Table**

<table>
<thead>
<tr>
<th>Source</th>
<th>DF:</th>
<th>Sum Squares:</th>
<th>Mean Square:</th>
<th>F-test:</th>
</tr>
</thead>
<tbody>
<tr>
<td>REGRESSION</td>
<td>5</td>
<td>244.621</td>
<td>48.924</td>
<td>12.942</td>
</tr>
<tr>
<td>RESIDUAL</td>
<td>67</td>
<td>253.27</td>
<td>3.78</td>
<td>p ≤ .0001</td>
</tr>
<tr>
<td>TOTAL</td>
<td>72</td>
<td>497.89</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Beta Coefficient Table**

<table>
<thead>
<tr>
<th>Parameter:</th>
<th>Value:</th>
<th>Std. Err.:</th>
<th>T-Value:</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>2.616</td>
<td>.535</td>
<td>4.89</td>
</tr>
<tr>
<td>AP</td>
<td>.132</td>
<td>.129</td>
<td>1.026</td>
</tr>
<tr>
<td>RP</td>
<td>.037</td>
<td>.137</td>
<td>.268</td>
</tr>
<tr>
<td>Cl</td>
<td>.531</td>
<td>.148</td>
<td>3.584 *</td>
</tr>
<tr>
<td>MI</td>
<td>.08</td>
<td>.125</td>
<td>.639</td>
</tr>
<tr>
<td>Training</td>
<td>-1.455</td>
<td>.835</td>
<td>-1.742</td>
</tr>
</tbody>
</table>

* p < .05
Table 13 shows that the multiple regression of the overall test produced an $F$ value of 12.94 ($p < .05$). These results suggest that at least one of the coefficients of the independent variables is different than zero. Examination of the beta coefficient table reveals that the variable chord production generated a $t$ of 3.584 ($p < .05$). This variable was successful in reducing the error sum of squares beyond that of the model. However, examination of the overall coefficient shows that only 49% of the variation in tonic production can be explained by the model. Thus, there is only marginal evidence to suggest that there is a linear relationship between tonic production and chord production abilities, and there is no evidence that a linear relationship exists between tonic production and the production skills for absolute pitch, relative pitch, melodic identification, and training.
Table 14 shows the results of a multiple regression analysis of tonic identification with results from both response tasks combined. This variable is measured against the remaining listening abilities with results from their response tasks combined and training.

**Table 14**

*Multiple Regression Analysis of Combined Response Tasks of Tonic Identification to Remaining Ability Measures with Response Tasks Combined and Training*

<table>
<thead>
<tr>
<th>Multiple - Y: TI Combined</th>
<th>Five X Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>DF:</td>
<td></td>
</tr>
<tr>
<td>72</td>
<td></td>
</tr>
<tr>
<td>R-squared:</td>
<td>.513</td>
</tr>
<tr>
<td>Std. Err.:</td>
<td>1.399</td>
</tr>
<tr>
<td>Coef. Var.:</td>
<td>24.208</td>
</tr>
</tbody>
</table>

**Analysis of Variance Table**

<table>
<thead>
<tr>
<th>Source</th>
<th>DF:</th>
<th>Sum Squares:</th>
<th>Mean Square:</th>
<th>F-test:</th>
</tr>
</thead>
<tbody>
<tr>
<td>REGRESSION</td>
<td>5</td>
<td>138.28</td>
<td>27.656</td>
<td>14.122</td>
</tr>
<tr>
<td>RESIDUAL</td>
<td>67</td>
<td>131.213</td>
<td>1.958</td>
<td><em>p ≤ .0001</em></td>
</tr>
<tr>
<td>TOTAL</td>
<td>72</td>
<td>269.493</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Beta Coefficient Table**

<table>
<thead>
<tr>
<th>Parameter:</th>
<th>Value:</th>
<th>Std. Err.:</th>
<th>T-Value:</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>3.387</td>
<td>.545</td>
<td>6.219</td>
</tr>
<tr>
<td>AP</td>
<td>.086</td>
<td>.148</td>
<td>.58</td>
</tr>
<tr>
<td>RP</td>
<td>-.052</td>
<td>.138</td>
<td>-.376</td>
</tr>
<tr>
<td>CI</td>
<td>.347</td>
<td>.136</td>
<td>2.551*</td>
</tr>
<tr>
<td>MI</td>
<td>.279</td>
<td>.125</td>
<td>2.227*</td>
</tr>
<tr>
<td>Training</td>
<td>-1.512</td>
<td>.666</td>
<td>-2.271*</td>
</tr>
</tbody>
</table>

* p < .05

An overall F value of 14.12 resulted from the regression analysis shown in Table 14. These results were significant beyond the chosen probability level (p < .05), indicating that one or more of the coefficients for the independent variables does not equal zero. Inspection of the beta coefficients in Table 14 reveals that the
variables chord identification ($t = 2.551$), melodic identification ($t = 2.227$) and training ($t = -2.271$) were significant beyond .05 and contributed to reducing the error sum of squares below that of the model. Inspection of the overall coefficient, however, shows that only 51% of the variation in tonic identification can be explained by the model. Thus, there is marginal evidence to suggest that there exists a linear relationship between tonic and chord identification abilities and training. There is no evidence that a linear relationship exists between tonic identification and to either absolute pitch or relative pitch.

Hypothesis 9 stated that tonic identification ability would not be accounted for by performance on tests of absolute pitch, relative pitch, chord identification and melodic identification, and training. In tonic recognition, none of the independent variables contributed significantly to subjects' performances. In tonic production however, marginal evidence was found to substantiate chord production ability as a factor. However, in the model for combined response tasks, results show that chord identification, melodic identification and training accounts for 51% of the variation in tonic identification. Therefore, hypothesis 9 is accepted totally for tonic recognition. This hypothesis could only be partially accepted for tonic production, as well as when response tasks were combined.
Table 15 shows the results of a multiple regression analysis of chord recognition to all other recognition response tasks and training.

### TABLE 15

**Multiple Regression Analysis of Chord Recognition to Remaining Recognition Response Tasks and Training**

- **Multiple - Y: Chord Recognition**
- **Five X Variables**

<table>
<thead>
<tr>
<th>DF</th>
<th>R-squared:</th>
<th>Std. Err.:</th>
<th>Coef. Var.:</th>
</tr>
</thead>
<tbody>
<tr>
<td>72</td>
<td>.832</td>
<td>1.553</td>
<td>31.749</td>
</tr>
</tbody>
</table>

#### Analysis of Variance Table

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Sum Squares:</th>
<th>Mean Square:</th>
<th>F-test:</th>
</tr>
</thead>
<tbody>
<tr>
<td>REGRESSION</td>
<td>5</td>
<td>801.604</td>
<td>160.321</td>
<td>66.503</td>
</tr>
<tr>
<td>RESIDUAL</td>
<td>67</td>
<td>161.519</td>
<td>2.411</td>
<td>p ≤ .0001</td>
</tr>
<tr>
<td>TOTAL</td>
<td>72</td>
<td>963.123</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Beta Coefficient Table

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value:</th>
<th>Std. Err.:</th>
<th>T-Value:</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>.245</td>
<td>.887</td>
<td>.276</td>
</tr>
<tr>
<td>AP</td>
<td>-.136</td>
<td>.15</td>
<td>-.906</td>
</tr>
<tr>
<td>RP</td>
<td>.51</td>
<td>.113</td>
<td>4.516 *</td>
</tr>
<tr>
<td>TI</td>
<td>.02</td>
<td>.116</td>
<td>.174</td>
</tr>
<tr>
<td>MI</td>
<td>.242</td>
<td>.116</td>
<td>2.081 *</td>
</tr>
<tr>
<td>Training</td>
<td>1.878</td>
<td>.736</td>
<td>2.551 *</td>
</tr>
</tbody>
</table>

*p < .05

Results in Table 15 show an $F$ value of 66.50 ($p < .05$) for the regression analysis with chord recognition as the dependent variable. This finding suggests that one or more of the independent variables in this model has a coefficient different from zero. The beta coefficients table reveals that relative pitch recognition, training and melodic recognition were significant in reducing the estimated standard error beyond that of the original model. The partial test of significance generated $t$ values of 4.516 for relative pitch recognition, 2.551 for
training and 2.081 for melodic recognition. These values were all significant beyond .05. Of these three variables, relative pitch recognition had the strongest effect on chord recognition. There is sufficient evidence to support the hypothesis that a linear relationship exists between chord recognition and relative pitch recognition, melodic recognition and training. These variables accounted for 83% of the variation in chord recognition.

Table 16 shows the results of a multiple regression analysis of chord production to all other production response tasks and training.

<table>
<thead>
<tr>
<th>TABLE 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple Regression Analysis of Chord Production to Remaining Production Response Tasks and Training</td>
</tr>
<tr>
<td>Multiple - Y: Chord Production</td>
</tr>
<tr>
<td>DF:</td>
</tr>
<tr>
<td>72</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Analysis of Variance Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
</tr>
<tr>
<td>REGRESSION</td>
</tr>
<tr>
<td>RESIDUAL</td>
</tr>
<tr>
<td>TOTAL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Beta Coefficient Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter:</td>
</tr>
<tr>
<td>INTERCEPT</td>
</tr>
<tr>
<td>AP</td>
</tr>
<tr>
<td>RP</td>
</tr>
<tr>
<td>TI</td>
</tr>
<tr>
<td>MI</td>
</tr>
<tr>
<td>Training</td>
</tr>
</tbody>
</table>

* p < .05
The regression analysis in Table 16 generated an $F$ value of 73.68 ($p < .05$) for the model with chord production as a dependent variable. This indicates that one or more of the independent variables has a coefficient different from zero. Further analysis shows that all variables except absolute pitch production were statistically significant in reducing the error sum of squares. Partial significance tests generated $t$ levels of 4.015 for training, 3.584 for tonic production, 3.383 for relative pitch production, and 2.216 for melodic production, all of which reached the .05 probability level. Of the independent variables training accounted for the most variation in performance on the chord production test. There is compelling evidence to suggest that there is a linear relationship between chord production and relative pitch production, tonic production, melodic production and training. Eighty-five of the variation in chord production can be explained by these variables.
Table 17 shows the results of a multiple regression analysis of chord identification with results from both response tasks combined. This variable is measured against the remaining listening abilities with results from their response tasks combined and training.

### TABLE 17

**Multiple Regression Analysis of Combined Response Tasks of Chord Identification to Remaining Ability Measures with Response Tasks Combined and Training**

<table>
<thead>
<tr>
<th>Multiple: Y</th>
<th>Cl Combined</th>
<th>Five X Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>DF:</td>
<td>R-squared:</td>
<td>Std. Err.:</td>
</tr>
<tr>
<td>72</td>
<td>.891</td>
<td>1.201</td>
</tr>
</tbody>
</table>

### Analysis of Variance Table

<table>
<thead>
<tr>
<th>Source</th>
<th>DF:</th>
<th>Sum Squares:</th>
<th>Mean Square:</th>
<th>F-test:</th>
</tr>
</thead>
<tbody>
<tr>
<td>REGRESSION</td>
<td>5</td>
<td>790.379</td>
<td>158.076</td>
<td>109.623</td>
</tr>
<tr>
<td>RESIDUAL</td>
<td>67</td>
<td>96.614</td>
<td>1.442</td>
<td>p ≤ .0001</td>
</tr>
<tr>
<td>TOTAL</td>
<td>72</td>
<td>886.993</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Beta Coefficient Table

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Std. Err.:</th>
<th>T-Value:</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>-1.17</td>
<td>.569</td>
<td>-2.055</td>
</tr>
<tr>
<td>AP</td>
<td>-.081</td>
<td>.127</td>
<td>-1.642</td>
</tr>
<tr>
<td>RP</td>
<td>.47</td>
<td>.104</td>
<td>4.533 *</td>
</tr>
<tr>
<td>TI</td>
<td>.255</td>
<td>.1</td>
<td>2.551 *</td>
</tr>
<tr>
<td>MI</td>
<td>.172</td>
<td>.11</td>
<td>1.571</td>
</tr>
<tr>
<td>Training</td>
<td>2.132</td>
<td>.532</td>
<td>4.004 *</td>
</tr>
</tbody>
</table>

* p < .05

The regression analysis in Table 17 produced an F value of 109.62 (p < .05). These results suggest that one or more of the beta coefficients does not equal zero. Further analysis of the results shows that relative pitch, training and tonic identification contributed significantly to reducing the estimated standard error beyond that of
the model. Partial tests generated t's of 4.433, 4.004 and 2.551, respectively, with probability rates on these variables greater than 95%. Results show that relative pitch and training were the most significant factors in this regression. Tonic identification was the least significant of the three. Together these variables accounted for 90% of the variation in chord identification. There is, therefore, overwhelming evidence to suggest that a linear relationship exists between chord identification and relative pitch, tonic identification and training level.

Hypothesis 10 stated that variation in chord identification ability would be accounted for by performance on tests of relative pitch and melodic identification, and training. Results show that training, relative pitch recognition and melodic recognition accounted for 83% of the variation in chord recognition ability. Relative pitch production, tonic production, melodic production and training accounted for 85% of the variation in chord production. When response tasks were combined 90% of the variation in chord identification was explained by relative pitch, tonic identification and training. Melodic identification was not significant in this model. Therefore, hypothesis 10 is totally accepted for chord recognition and chord production and partially accepted for the model with response tasks combined.
Table 18 shows the results of a multiple regression analysis of melodic recognition to all other recognition response tasks and training.

| TABLE 18 |
|-----------------|-----------------|-----------------|
| **Multiple Regression Analysis of Melodic Recognition to Remaining Recognition Response Tasks and Training** |
| Multiple - Y: Melodic Recognition | Five X Variables |
| DF: | R-squared: | Std. Err.: | Coef. Var.: |
| 72 | .781 | 1.581 | 24.006 |

<table>
<thead>
<tr>
<th>Analysis of Variance Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
</tr>
<tr>
<td>REGRESSION</td>
</tr>
<tr>
<td>RESIDUAL</td>
</tr>
<tr>
<td>TOTAL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Beta Coefficient Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter:</td>
</tr>
<tr>
<td>INTERCEPT</td>
</tr>
<tr>
<td>AP</td>
</tr>
<tr>
<td>RP</td>
</tr>
<tr>
<td>TI</td>
</tr>
<tr>
<td>CI</td>
</tr>
<tr>
<td>Training</td>
</tr>
</tbody>
</table>

* p < .05

Results show that the regression analysis for melodic recognition generated an overall F value of 47.82 (p < .05). These results indicate that at least one of the independent variables in this model does not equal zero. Results in the beta coefficients table show that training (t = 2.512), relative pitch recognition (t = 2.196) and chord recognition (t = 2.081) were significant in reducing the error sum of squares.
beyond that of the original model. All surpassed the .05 level of significance, providing sufficient evidence that there exists a linear relationship between melodic recognition and training, relative pitch recognition and chord recognition. Seventy-eight percent of the variation on the melodic recognition test can be explained by these variables.

Table 19 shows the results of a multiple regression analysis of melodic production to all other production response tasks and training.

### TABLE 19

**Multiple Regression Analysis of Melodic Production to Remaining Production Response Tasks and Training**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Std. Err.</th>
<th>T-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>1.032</td>
<td>.595</td>
<td>1.734</td>
</tr>
<tr>
<td>AP</td>
<td>-.075</td>
<td>.126</td>
<td>-.596</td>
</tr>
<tr>
<td>RP</td>
<td>.378</td>
<td>.125</td>
<td>3.023 *</td>
</tr>
<tr>
<td>TI</td>
<td>.076</td>
<td>.119</td>
<td>.639</td>
</tr>
<tr>
<td>CI</td>
<td>.338</td>
<td>.153</td>
<td>2.216 *</td>
</tr>
<tr>
<td>Training</td>
<td>2.146</td>
<td>.792</td>
<td>2.71 *</td>
</tr>
</tbody>
</table>

*p < .05*
Results show that the regression of the overall test generated an $F$ value of 44.83 ($p < .05$) which implies that one or more of the independent variables has a coefficient different from zero. Beta coefficients in Table 19 show significant $t$ statistics for relative pitch production, training and chord production, each reaching beyond the established probability level of .05. Their respective values were 3.023, 2.71 and 2.216, enabling a reduction in the error sum of squares. These findings show that relative pitch production contributed most to $r^2$. Combined, these variables accounted for 77% of the variation in melodic production, providing substantial evidence that a linear relationship exists between melodic production and relative pitch production, chord production and training.
Table 20 shows the results of a multiple regression analysis of melodic identification with results from both response tasks combined. This variable is measured against the remaining listening abilities with results from their response tasks combined and training.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Std. Err.</th>
<th>T-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>1.081</td>
<td>.629</td>
<td>1.718</td>
</tr>
<tr>
<td>AP</td>
<td>-.125</td>
<td>.138</td>
<td>-.903</td>
</tr>
</tbody>
</table>
| RP              | .447  | .118      | 3.792   | *  
| TI              | .247  | .111      | 2.227   | *  
| Cl              | .206  | .131      | 1.571   |
| Training        | 1.719 | .614      | 2.798   | *  

* p < .05

The multiple regression analysis in Table 20 produced an F value of 83.22 (p < .05), which suggest that one or more of the beta coefficients does not equal zero. Further examination reveals that relative pitch, training and tonic identification contributed significantly to reducing the estimated standard error beyond that of
the model. Partial tests of significance resulted in \( t \) values of 3.789, 2.798 and 2.227, respectively, with probability ratings on these variables greater than 95%. Results show that relative pitch and training were the most significant factors in this regression. Tonic identification was the least significant of the three. Together these variables accounted for 86% of the variation in melodic identification. Thus, the evidence is substantial to suggest that a linear relationship exists between melodic identification and relative pitch, tonic identification and training.

Hypothesis 11 stated that variation in melodic identification ability would be accounted for by performance on tests of relative pitch and chord identification, and training. Results show that on the melodic recognition response task, 78% of performance variation was explained by relative pitch recognition, chord recognition and training. These same abilities accounted for 77% of the variation on the production response task. The effect of chord identification was insignificant when response tasks were combined. Collectively, relative pitch, tonic identification and training accounted for 86% of the variation in melodic identification. Therefore, hypothesis 11 is accepted totally for melodic recognition and production and only partially when response tasks are combined.
Table 21 shows correlation coefficients for the formally trained subjects across absolute pitch, relative pitch, tonic identification, chord identification and melodic identification.

<table>
<thead>
<tr>
<th></th>
<th>AP</th>
<th>RP</th>
<th>TI</th>
<th>CI</th>
<th>MI</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP</td>
<td>0.430</td>
<td>0.222</td>
<td>0.320</td>
<td>0.256</td>
<td></td>
</tr>
<tr>
<td>RP</td>
<td>0.444</td>
<td>0.624</td>
<td>0.661</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TI</td>
<td>0.550</td>
<td></td>
<td>0.464</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CI</td>
<td></td>
<td></td>
<td></td>
<td>0.618</td>
<td></td>
</tr>
</tbody>
</table>

Results show fairly strong relationships between relative pitch and chord identification, relative pitch and melodic identification, and chord identification and melodic identification. The correlation between relative pitch and melodic identification was highest of all. Moderate relationship are shown between absolute pitch and relative pitch, between relative pitch and tonic identification, between tonic identification and chord identification, and between tonic identification and melodic identification. Except for the correlation between absolute pitch and relative pitch, the other relationships involving absolute pitch were low, with the lowest of these occurring between absolute pitch and tonic identification.
Table 22 shows correlation coefficients for the informally trained subjects across absolute pitch, relative pitch, tonic identification, chord identification and melodic identification.

<table>
<thead>
<tr>
<th></th>
<th>RP</th>
<th>TI</th>
<th>CI</th>
<th>MI</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP</td>
<td>-0.294</td>
<td>-0.147</td>
<td>-0.359</td>
<td>-0.361</td>
</tr>
<tr>
<td>RP</td>
<td>0.427</td>
<td>0.881</td>
<td>0.716</td>
<td></td>
</tr>
<tr>
<td>TI</td>
<td></td>
<td>0.529</td>
<td>0.606</td>
<td></td>
</tr>
<tr>
<td>CI</td>
<td></td>
<td></td>
<td>0.665</td>
<td></td>
</tr>
</tbody>
</table>

Results show very strong relationships between the music listening abilities of relative pitch and chord identification, and between relative pitch and melodic identification. Relationships between chord identification and melodic identification, and between tonic identification and melodic identification were not as strong. Moderate relationships were found between relative pitch and tonic identification, and between tonic identification and chord identification. All relationships involving absolute pitch were weak. As in the correlations for trained subjects' responses, the weakest relationship occurred between absolute pitch and tonic identification.
Table 23 shows correlation coefficients for all subjects across absolute pitch, relative pitch, tonic identification, chord identification and melodic identification.

<table>
<thead>
<tr>
<th></th>
<th>RP</th>
<th>TI</th>
<th>CI</th>
<th>MI</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP</td>
<td>0.417</td>
<td>0.267</td>
<td>0.351</td>
<td>0.331</td>
</tr>
<tr>
<td>RP</td>
<td>0.629</td>
<td>0.907</td>
<td>0.893</td>
<td></td>
</tr>
<tr>
<td>TI</td>
<td>0.673</td>
<td></td>
<td>0.668</td>
<td></td>
</tr>
<tr>
<td>CI</td>
<td></td>
<td></td>
<td></td>
<td>0.895</td>
</tr>
</tbody>
</table>

Results in Table 23 show very high correlations between relative pitch and chord identification, between relative pitch and melodic identification, and between chord identification and melodic identification. Most of the correlations involving tonic identification resulted in fairly strong relationships. The correlation between absolute pitch and relative pitch was moderate. All other correlations involving absolute pitch generated weak relationships. Performances on absolute pitch and tonic identification produced the weakest relationship of all.
Hypothesis 12 stated that mean scores on absolute pitch tests would not relate strongly and positively to mean scores on tests of tonic identification, chord identification and melodic identification. Results show that the strongest relationships involving absolute pitch occurred between absolute pitch and relative pitch in the trained subjects and in an analysis of the total subject population. These relationships were only of moderate strength at best. Therefore, hypothesis 12 is accepted.

Hypothesis 13 stated the mean scores on relative pitch tests would relate strongly and positively to mean scores on tests of chord identification and melodic identification. Results show the existence of fairly strong and positive relationships between relative pitch and chord identification, and between relative pitch and melodic identification in the trained musicians. Very high correlations resulted from these same relationships in the untrained musicians, and across the total subject population. Therefore, hypothesis 13 is accepted.

Hypothesis 14 stated that mean scores on tonic identification tests would not relate strongly and positively to mean scores on tests of relative pitch, chord identification and melodic identification. Results show moderate relationships between tonic identification and these abilities in the trained subjects. For the untrained subjects, results were similar for the most part. Results show a fairly strong relationship between tonic identification and melodic identification.
In observing the total subject population, results show fairly strong relationships between tonic identification and relative pitch, and between chord identification and melodic identification. Therefore, hypothesis 14 can only be accepted partially.

Hypothesis 15 stated that mean scores on chord identification tests would relate strongly and positively to mean scores on tests of melodic identification. Fairly strong relationships were found between these abilities in both formally and informally trained musicians. A very high and positive correlation was discovered between chord identification and melodic perception in the total subject population. Therefore, hypothesis 15 is accepted.
CHAPTER V
SUMMARY AND DISCUSSION

PURPOSE OF THE STUDY

The purposes of this study were to:

1. Review published experimental research and standardized tests that measure differences and relationships among the abilities absolute pitch, relative pitch, tonic identification, chord identification and melodic identification.

2. Administer tests of absolute pitch, relative pitch, tonic identification, chord identification and melodic identification to groups of formally and informally trained musicians.

3. Compare scores on these ability measures within and between both groups of musicians.

4. Compare scores on these measures for two types of responses: recognition and production.

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LIMITATIONS OF THE STUDY

This study was limited to the following:

1. A review of published experimental research and standardized tests of musical ability that tests for one or more of the abilities measured in the present study.

2. An investigation of differences and relationships among the abilities absolute pitch, relative pitch, tonic identification, chord identification and melodic identification.

3. A comparison of results between formally and informally trained musicians.


REVIEW OF LITERATURE

The review of studies on absolute pitch, relative pitch, tonic identification, chord identification and melodic identification investigated published research and standardized tests of these abilities.

This review indicated that there is an enormous amount of experimental literature on absolute pitch. Some authors have
suggested that possessors of absolute pitch use an anchoring technique in pitch identification by comparing a target tone to one or more internal reference tones stored in long-term memory. This view of pitch perception hints at the possibility of a functional relationship between absolute pitch and relative pitch. Others propose that absolute pitch possessors are able to identify the individual characteristics of a tone through its tone chroma. This theory proposes that each tone possesses aural attributes extraneous to other tones that can only be perceived by individuals with absolute pitch. Nevertheless, this review has shown that any advantage absolute pitch possessors have on isolated pitch tasks decreases in listening conditions that simulate natural music settings, especially when absolute pitch possessors lack other music listening skills. Furthermore, in some musical situations, other listening skills may be more germane than absolute pitch.

A small number of studies account for effects that other listening skills might have on relative pitch ability. And of those that consider specific interval size discrimination, much emphasis is placed on the scientific basis of natural law theory. However, others propose that intervals which are easier to perceive and/or those that recur frequently contribute most to the perception of such musical entities as chords, melodies and keys.

Many suggest that tonic identification skill is a result of one perceiving such musical entities as chords, scale tones or sequences.
However, others have shown that it is only when these elements are strategically positioned in tonal music can they influence tonic perception most clearly. These studies have shown that set membership alone is not enough.

In researching a large number of published standardized tests of music ability, it was discovered that:

1. Absolute pitch tasks have been omitted by these authors. This may be due to the difficulty of measuring this ability accurately in a typical testing environment.

2. Relative pitch tasks are included in many standardized tests, but a smaller portion actually measure subjects' ability to make specific interval size discriminations.

3. A smaller number measure tonic identification ability. These include tests that require subjects to indicate whether a musical excerpt is tonal or non tonal and those that request subjects to name specific cadences and modulations.

4. Several have tested for chord identification ability. These range from tasks requiring subjects to identify when and if chords change to more complicated measures that test subjects ability to identify chord qualities.

5. The majority of standardized tests include measures of melodic identification. Many only require subjects to make same vs.
different judgments when comparing two melodies. However, others range from having subjects compare aural presentations to printed scores to requesting that subjects sight-sing with solfege syllables. Several include tests that mandate melodic dictation skill and a small number allow subjects to reproduce their responses on musical instruments.

Finally, few correlational studies were found, none that attempt to show existing relationships among the music listening abilities investigated in the present study. The majority of existing comparative studies discovered only summarize and rate the validity and reliability levels of existing standardized tests.

**SUBJECTS**

Subjects were selected from two populations. Half were formally trained musicians with levels of academic training ranging from sophomore to graduate student. The other half were musicians with no formal training in music. These subjects had extensive experience with gospel and popular music ensembles and were currently participating in one or more of these ensembles.
METHOD

The test was divided into a recognition and a production segment. Each segment contained five different ability measures: absolute pitch, relative pitch, tonic identification, chord identification and melodic identification. The formally and informally trained musicians were tested on each of the ability measures within the recognition and production tasks.

STATISTICAL ANALYSES

The following statistical procedures were used in this study: (1) T-tests identified differences in mean scores between the formally and informally trained subjects; (2) two-way analyses of variance measured interaction effects among the ability measures in the formally and informally trained musicians; (3) multiple regression analyses identified relationships between each ability and combinations of other abilities and training level; and (4) correlation coefficients identified simple relationships between paired abilities in the formally trained, informally trained and combined groups of musicians.
RESULTS

The following results are based on the statistical procedures described in Chapter IV.

**t Tests**

1. Hypothesis 1 stated that mean scores of trained subjects would be significantly higher than mean scores of untrained subjects on tests of absolute pitch. Results show that differences between subjects' performance on these tests are only significant for the production response task, $t = 3.767$ ($p < .01$). The eta square measure of practical significance validated the meaningfulness of this difference. The untrained musicians performed as well as the trained musicians on the test for absolute pitch recognition, $t = .281$. Therefore, hypothesis 1 can only be accepted for absolute pitch production.

2. Hypothesis 2 stated that mean scores of trained subjects would be significantly higher than mean scores on untrained subjects on tests of relative pitch. Results show that the trained musicians' performance levels were significantly higher than those of the untrained musicians on both relative pitch recognition and production. $T$ values for these measures were $12.277$ ($p < .01$) and $8.599$ ($p < .01$), respectively. The eta
square measure of practical significance substantiated these findings. Therefore, hypothesis 2 is accepted.

3. Hypothesis 3 stated that mean scores of trained subjects would be significantly higher than mean scores of untrained subjects on tests of tonic identification. Results showed that mean scores between the trained and untrained musicians were statistically significant on both response tasks, i.e., $t = 3.422$ ($p < .01$) for tonic recognition and $t = 4.606$ ($p < .01$) for tonic production. However, the eta tests for practical significance established a lack in meaningfulness between mean scores on tonic recognition. A magnitude of only .14 was found for the difference in training on tonic recognition. Therefore, hypothesis 3 can only be accepted for tonic production.

4. Hypothesis 4 stated that mean scores of trained subjects would be significantly higher than mean scores of untrained subjects on tests of chord identification. Results indicated that the trained musicians' performance levels were significantly higher than those of the untrained musicians on both chord identification response tasks. Mean differences generated $t$ values of 13.314 ($p < .01$) for chord recognition and 11.833 ($p < .01$) for chord production. Furthermore, eta square statistics substantiated these findings. Therefore, hypothesis 4 is accepted.
5. Hypothesis 5 stated that mean scores of trained subjects would be significantly higher than mean scores of untrained subjects on tests of melodic identification. Analysis of data generated $t$ values of 12.245 ($p < .01$) for melodic recognition and 10.654 ($p < .01$) for melodic production. Eta square statistics substantiated these findings. Therefore, hypothesis 5 is accepted.

**Two-Way Analysis of Variance**

6. Hypothesis 6 stated that relative differences among tests of music identification would not be the same between trained and untrained musicians. Results show that training plays a less important role in the possession of absolute pitch and tonic identification abilities than in relative pitch, chord identification and melodic identification abilities. These findings were consistent throughout measures for recognition and production response tasks, as well as when response tasks were combined. Therefore, hypothesis 6 is accepted.

**Multiple Regressions**

7. Hypothesis 7 stated that variation in absolute pitch ability would not be accounted for by performance on tests of relative pitch, tonic identification, chord identification and melodic identification, and training. Overall, results show that only 19% of the variation in absolute was explained by these
abilities. This finding was consistent with results from comparisons of absolute pitch to production response tasks and training level. Twenty-one percent of performance variance was accounted for under this condition. This percentage diminished considerably for comparisons to absolute pitch recognition. Only 6% of its performance variance was explained by the other recognition tasks and training. Therefore, based on these observations, hypothesis 7 is accepted.

8. Hypothesis 8 stated that variation in relative pitch ability would be accounted for by performance on tests of chord and melodic identification, and training. Overall, results show that 87% of the variation in relative pitch could be accounted for. In addition to the significant contributions of chord and melodic identification abilities, absolute pitch contributed to this relationship also, though accounting for the least amount of variation in relative pitch. Chord identification contributed most to this relationship. Results varied slightly for comparisons on each response task. Absolute pitch was not a significant factor in the production model and the significance of training was limited to the recognition condition only. Therefore, hypothesis 8 is accepted totally for chord and melodic identification, and only in part for training.
9. Hypothesis 9 stated that tonic identification ability would not be accounted for by performance on tests of absolute pitch, relative pitch, chord identification and melodic identification, and training. In tonic recognition, none of the independent variables contributed significantly to subjects' performances. In tonic production, however, marginal evidence was found to substantiate chord production ability as a factor. However, in the model for combined response tasks, results showed that chord identification, melodic identification and training accounted for 51% of the variation in tonic identification. Therefore, hypothesis 9 was accepted totally for tonic recognition. This hypothesis could only be partially accepted for tonic production, as well as when response tasks were combined.

10. Hypothesis 10 stated that variations in chord identification ability would be accounted for by performance on tests of relative pitch and melodic identification, and training. Results show that training, relative pitch recognition and melodic recognition accounted for 83% of the variation in chord recognition ability. Relative pitch production, tonic production, melodic production and training accounted for 85% of the variation in chord production. When response tasks were combined, 90% of the variation in chord identification was explained by relative pitch, tonic
identification, and training. Melodic identification was not significant in this model. Therefore, hypothesis 10 is totally accepted for chord recognition and chord production and partially accepted for the model with response tasks combined.

11. Hypothesis 11 stated that variation in melodic identification ability would be accounted for by performance on tests of relative pitch and chord identification, and training. Results show that on the melodic recognition response task, 78% of performance variation was explained by relative pitch recognition, chord recognition and training. These same abilities accounted for 77% of the variation on the production response task. The effect of chord identification was insignificant when response tasks were combined. Collectively, relative pitch, tonic identification and training accounted for 86% of the variation in melodic identification. Therefore, hypothesis 11 is accepted totally for melodic recognition and production and only partially when response tasks are combined.

Correlation Coefficients

12. Hypothesis 12 stated that mean scores on absolute pitch tests would not relate strongly and positively to mean scores on tests of tonic identification, chord identification and melodic identification. Results show that the strongest relationships involving absolute pitch occurred between absolute pitch and
relative pitch in the trained subjects and in an analysis of the
total subject population. These relationships were only
moderate at best. Therefore, hypothesis 12 is accepted.

13. Hypothesis 13 stated the mean scores on relative pitch tests
would relate strongly and positively to mean scores on tests of
chord identification and melodic identification. Results show
the existence of fairly strong and positive relationships
between relative pitch and chord identification and relative
pitch and melodic identification in the trained musicians. Very
high correlations resulted from these same relationships in the
untrained musicians and the total subject population.
Therefore, hypothesis 13 is accepted.

14. Hypothesis 14 stated that mean scores on tonic identification
tests would not relate strongly and positively to mean scores on
tests of relative pitch, chord identification and melodic
identification. Results show moderate relationships between
tonic identification and these abilities in the trained subjects.
Findings were similar for the untrained subjects. Results show
a fairly strong relationship between tonic identification and
melodic identification. In observing the total subject
population, results show fairly strong relationships between
tonic identification and relative pitch, chord identification and
melodic identification. Therefore, hypothesis 14 can only be
partially accepted.
15. Hypothesis 15 stated that mean scores on chord identification tests would relate strongly and positively to mean scores on tests of melodic identification. Fairly strong relationships were found between these abilities in both formally and informally trained musicians. A very high and positive correlation was discovered between chord identification and melodic identification in the total subject population. Therefore, hypothesis 15 is accepted.

CONCLUSIONS

The following conclusions are based on the purposes, limitations and results of the present study.

1. The presence of absolute pitch ability is not enhanced significantly by one's possession of other music listening skills. Formally and informally trained musicians perform equally poorly on these tasks. The slight advantage that formally trained musicians without absolute pitch may exhibit must be credited to their ability to incorporate listening skills that would facilitate tone comparisons and labeling, e.g., relative pitch.

2. There does not exist a strong relationship between absolute pitch and the abilities relative pitch, tonic identification, chord
identification or melodic identification. The relationship between absolute pitch and relative pitch is moderate at best.

3. Relative pitch ability is significantly stronger in musicians with formal training than in those without. Furthermore, the knowledge, or lack thereof, of the labeling system associated with completing this and other similar tasks, e.g., chord spelling and melodic dictation, contributes to subjects' performance accuracy.

4. Relative pitch ability increases as the abilities of chord identification, melodic identification and absolute pitch increase, collectively. Overall, chord identification and melodic identification are more important to relative pitch than is absolute pitch. The respective relationships of chord identification and melodic identification to relative pitch are strong as well. Because specific interval size discriminations are necessary in completing more sophisticated measures of chord and melodic identification abilities, it is conceivable that relationships between these skills would be strong.

5. Tonic identification ability is found in informally trained musicians more than other music listening abilities. While formally trained musicians perform consistently better on tests of tonic production, the untrained musicians perform as well on tests on tonic recognition. All musicians have less trouble distinguishing whether tonal stimuli represent the tonal center
of compositions than in generating tonics vocally. This is also true for most music recognition response tasks.

6. Tonic identification ability is slightly enhanced by chord and melodic identification abilities under production response task conditions only. Performance on tonic recognition tests can not be easily explained by musicians' performance on other music listening tasks or by their training level.

7. Overall, tonic identification has a fairly strong relationship with the abilities of relative pitch, chord identification and melodic identification, individually. These relationships are not as strong in separate groups of trained and untrained musicians.

8. Musicians with formal training consistently perform better on tests of chord identification than do informally trained musicians. As in relative pitch, knowledge of the labeling system undoubtedly contributes to this difference.

9. Overall, chord identification ability is enhanced by the combination of musicians' training level, relative pitch ability and tonic identification abilities, and in that order. Melodic identification contributes more to this ability when recognition and production response tasks are isolated. Furthermore, tonic identification ability does not enhance chord identification ability under recognition response conditions alone.
10. Chord identification has a strong relationship with relative pitch and melodic identification for both modes of response and for both groups.

11. Formally trained musicians possess higher levels of melodic identification ability than informally trained musicians. This is especially true for more sophisticated measures where subjects must read and write music.

12. Collectively, relative pitch ability, chord identification ability and training level are significant predictors of performance on both melodic recognition and melodic production tests. The influence of these abilities changes, however, when melodic identification response tasks are combined. Training level, relative pitch and tonic identification abilities are the best predictors of melodic identification in this situation.

13. Melodic identification ability is stronger in formally trained musicians than any other music listening skill.

In order to make proper comparisons between formally and informally trained musicians it was necessary to test musicians without formal training on measures in which they were obviously at a disadvantage. While less sophisticated test designs could have been used, the aim of this study focused on listening tasks that were more representative of college ear-training examinations. Therefore,
conclusions drawn from this study can only be applied to conditions where training levels and response tasks are similar.

Because of limitations in the present study, recommendations for further research is suggested. The effects that adding more variables to the original model might have on each listening ability should be tested. Further research might study these abilities in professional musicians and in non-musicians. Finally, consideration could be given to such factors as gender, age and race.

GENERAL DISCUSSION

This study has given some insight into the music listening abilities of musicians with and without formal training. While untrained musicians are at a disadvantage when forced to use notation or unfamiliar terms to describe such entities as intervals and chords, they perform much better on these tests than might be expected. Years of learning music by rote seem to have equipped them with skills that often measure up to listening abilities found in formally trained musicians.

Primarily, I thought that if traits and patterns could be identified in the music listening abilities of both the formally and informally trained musician, the methodology for teaching music aural skills would improve. In other words, if there were conditions that would enhance one's possession of certain music listening abilities, knowledge of
these conditions would be most beneficial to teaching aural skills. This study has shown that such conditions do exist.

There is a wide spread assumption that musicians who possess absolute pitch are musically superior to other musicians. This research has shown, however, that variations in relative pitch, tonic identification, chord identification and melodic identification abilities are least accounted for by absolute pitch ability. Furthermore, in comparison to relative pitch, chord identification and melodic identification abilities, tonic identification ability can not be easily explained by the possession of other of these abilities or one's training level. Informally trained musicians possess higher levels of tonic identification ability than they do any of the other abilities tested. Of the abilities tested, the strongest relationships were found among the abilities of relative pitch, chord identification and melodic identification in both groups of musicians. Finally, the evidence reveals that informally trained musicians perform as well as do formally trained musicians on tests of tonic and absolute pitch recognition.

This study has shown that skills musicians use in completing specific listening tasks are multi-faceted and may vary tremendously from one musician to the next. Often, untested opinions ranking one ability more important than others are erroneous. While musicians' performance accuracy levels can easily be determined on tests of
music identification, the skills they use to successfully complete these tasks are not as easily determined.
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Figure 6. Response accuracy levels for formally trained subject #1 on recognition and production listening tasks.
Figure 7. Response accuracy levels for formally trained subject #2 on recognition and production listening tasks.

Figure 8. Response accuracy levels for formally trained subject #3 on recognition and production listening tasks.
Figure 9. Response accuracy levels for formally trained subject #4 on recognition and production listening tasks.

Figure 10. Response accuracy levels for formally trained subject #5 on recognition and production listening tasks.
Figure 11. Response accuracy levels for formally trained subject #6 on recognition and production listening tasks.

Figure 12. Response accuracy levels for formally trained subject #7 on recognition and production listening tasks.
Figure 13. Response accuracy levels for formally trained subject #8 on recognition and production listening tasks.

Figure 14. Response accuracy levels for formally trained subject #9 on recognition and production listening tasks.
Figure 15. Response accuracy levels for formally trained subject #10 on recognition and production listening tasks.

Figure 16. Response accuracy levels for formally trained subject #11 on recognition and production listening tasks.
Figure 17. Response accuracy levels for formally trained subject #12 on recognition and production listening tasks.

Figure 18. Response accuracy levels for formally trained subject #13 on recognition and production listening tasks.
**Figure 19.** Response accuracy levels for formally trained subject #14 on recognition and production listening tasks.

**Figure 20.** Response accuracy levels for formally trained subject #15 on recognition and production listening tasks.
Figure 21. Response accuracy levels for formally trained subject #16 on recognition and production listening tasks.

Figure 22. Response accuracy levels for formally trained subject #17 on recognition and production listening tasks.
**Figure 23.** Response accuracy levels for formally trained subject #18 on recognition and production listening tasks.

**Figure 24.** Response accuracy levels for formally trained subject #19 on recognition and production listening tasks.
Figure 25. Response accuracy levels for formally trained subject #20 on recognition and production listening tasks.

Figure 26. Response accuracy levels for formally trained subject #21 on recognition and production listening tasks.
Figure 27. Response accuracy levels for formally trained subject #22 on recognition and production listening tasks.

Figure 28. Response accuracy levels for formally trained subject #23 on recognition and production listening tasks.
Figure 29. Response accuracy levels for formally trained subject #24 on recognition and production listening tasks.

Figure 30. Response accuracy levels for formally trained subject #25 on recognition and production listening tasks.
Figure 31. Response accuracy levels for formally trained subject #26 on recognition and production listening tasks.

Figure 32. Response accuracy levels for formally trained subject #27 on recognition and production listening tasks.
Figure 33. Response accuracy levels for formally trained subject #28 on recognition and production listening tasks.

Figure 34. Response accuracy levels for formally trained subject #29 on recognition and production listening tasks.
Figure 35. Response accuracy levels for formally trained subject #30 on recognition and production listening tasks.

Figure 36. Response accuracy levels for formally trained subject #31 on recognition and production listening tasks.
Figure 37. Response accuracy levels for formally trained subject #32 on recognition and production listening tasks.

Figure 38. Response accuracy levels for formally trained subject #33 on recognition and production listening tasks.
Figure 39. Response accuracy levels for formally trained subject #34 on recognition and production listening tasks.

Figure 40. Response accuracy levels for formally trained subject #35 on recognition and production listening tasks.
Figure 41. Response accuracy levels for formally trained subject #36 on recognition and production listening tasks.

Figure 42. Response accuracy levels for formally trained subject #37 on recognition and production listening tasks.
**Figure 43.** Response accuracy levels for formally trained subject #38 on recognition and production listening tasks.
APPENDIX B

RESPONSE ACCURACY LEVELS OF INFORMALLY TRAINED MUSICIANS

Figure 44. Response accuracy levels for informally trained subject #1 on recognition and production listening tasks.
Figure 45. Response accuracy levels for informally trained subject #2 on recognition and production listening tasks.

Figure 46. Response accuracy levels for informally trained subject #3 on recognition and production listening tasks.
Figure 47. Response accuracy levels for informally trained subject #4 on recognition and production listening tasks.

Figure 48. Response accuracy levels for informally trained subject #5 on recognition and production listening tasks.
Figure 49. Response accuracy levels for informally trained subject #6 on recognition and production listening tasks.

Figure 50. Response accuracy levels for informally trained subject #7 on recognition and production listening tasks.
**Figure 51.** Response accuracy levels for informally trained subject #8 on recognition and production listening tasks.

**Figure 52.** Response accuracy levels for informally trained subject #9 on recognition and production listening tasks.
**Figure 53.** Response accuracy levels for informally trained subject #10 on recognition and production listening tasks.

**Figure 54.** Response accuracy levels for informally trained subject #11 on recognition and production listening tasks.
Figure 55. Response accuracy levels for informally trained subject #12 on recognition and production listening tasks.

Figure 56. Response accuracy levels for informally trained subject #13 on recognition and production listening tasks.
Figure 57. Response accuracy levels for informally trained subject #14 on recognition and production listening tasks.

Figure 58. Response accuracy levels for informally trained subject #15 on recognition and production listening tasks.
**Figure 59.** Response accuracy levels for informally trained subject #16 on recognition and production listening tasks.

**Figure 60.** Response accuracy levels for informally trained subject #17 on recognition and production listening tasks.
**Figure 61.** Response accuracy levels for informally trained subject #18 on recognition and production listening tasks.

**Figure 62.** Response accuracy levels for informally trained subject #19 on recognition and production listening tasks.
Figure 63. Response accuracy levels for informally trained subject #20 on recognition and production listening tasks.

Figure 64. Response accuracy levels for informally trained subject #21 on recognition and production listening tasks.
Figure 65. Response accuracy levels for informally trained subject #22 on recognition and production listening tasks.

Figure 66. Response accuracy levels for informally trained subject #23 on recognition and production listening tasks.
**Figure 67.** Response accuracy levels for informally trained subject #24 on recognition and production listening tasks.

**Figure 68.** Response accuracy levels for informally trained subject #25 on recognition and production listening tasks.
Figure 69. Response accuracy levels for informally trained subject #26 on recognition and production listening tasks.

Figure 70. Response accuracy levels for informally trained subject #27 on recognition and production listening tasks.
Figure 71. Response accuracy levels for informally trained subject #28 on recognition and production listening tasks.

Figure 72. Response accuracy levels for informally trained subject #29 on recognition and production listening tasks.
Figure 73. Response accuracy levels for informally trained subject #30 on recognition and production listening tasks.

Figure 74. Response accuracy levels for informally trained subject #31 on recognition and production listening tasks.
**Figure 75.** Response accuracy levels for informally trained subject #32 on recognition and production listening tasks.

**Figure 76.** Response accuracy levels for informally trained subject #33 on recognition and production listening tasks.
Figure 77. Response accuracy levels for informally trained subject #34 on recognition and production listening tasks.

Figure 78. Response accuracy levels for informally trained subject #35 on recognition and production listening tasks.
APPENDIX C

MUSIC LISTENING ABILITY MEASURE

RECOGNITION TEST

I. **Absolute Pitch:** Write the letter names of the tones you hear in the spaces below. Each tone will be followed by a three-second pause, during which you must write your response.

A. _________ G. _________
B. _________ H. _________
C. _________ I. _________
D. _________ J. _________
E. _________ K. _________
F. _________ L. _________

II. **Relative Pitch:** Circle the correct response for each interval you hear. Intervals will either be harmonic, melodic ascending or melodic descending. Each interval will be played twice.

A. P8 M7 m7 M6 m6 P5 TT P4 M3 m3 M2 m2 PP
B. P8 M7 m7 M6 m6 P5 TT P4 M3 m3 M2 m2 PP
C. P8 M7 m7 M6 m6 P5 TT P4 M3 m3 M2 m2 PP
D. P8 M7 m7 M6 m6 P5 TT P4 M3 m3 M2 m2 PP
E. P8 M7 m7 M6 m6 P5 TT P4 M3 m3 M2 m2 PP
F. P8 M7 m7 M6 m6 P5 TT P4 M3 m3 M2 m2 PP
G. P8 M7 m7 M6 m6 P5 TT P4 M3 m3 M2 m2 PP

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III. **Tonic Identification:** You will hear short excerpts of major or minor tonal compositions, after which you will hear a tone. If the tone you hear matches the tonal center of the composition write *yes* in the appropriate space below. If it does not match the tonal center write *no*.

A. ___________ F. ___________
B. ___________ G. ___________
C. ___________ H. ___________
D. ___________ I. ___________
E. ___________ J. ___________

IV. **Chord Identification:** You will hear a series of triads and seventh chords, arpeggiated and blocked. After each hearing you are to identify the quality of the chord by circling the correct response from the given list.

A. d m M A dd dm mm Mm MM
B. d m M A dd dm mm Mm MM
C. d m M A dd dm mm Mm MM
D. d m M A dd dm mm Mm MM
E. d m M A dd dm mm Mm MM
F. d m M A dd dm mm Mm MM
G. d m M A dd dm mm Mm MM
H. d m M A dd dm mm Mm MM
I. d m M A dd dm mm Mm MM
J. d m M A dd dm mm Mm MM
V. Melodic Identification: You will hear a series of melodies. After each hearing you are to identify the melody heard from those notated below by marking an "X" beside the appropriate melody. Each melody will be played three times.

A.

```
\begin{music}
\begin{bass}c4\end{bass} e d c \quad c4 e f g \quad c4 e f g \quad c4 e f g
\end{music}
```

B.

```
\begin{music}
\begin{bass}c4\end{bass} e d c \quad c4 e f g \quad c4 e f g \quad c4 e f g
\end{music}
```
PRODUCTION TEST

I. Absolute Pitch: Sing, whistle or hum the tones requested in your most comfortable vocal range.

A. ___________  G. ___________
B. ___________  H. ___________
C. ___________  I. ___________
D. ___________  J. ___________
E. ___________  K. ___________
F. ___________  L. ___________

II. Relative Pitch: You will hear a series of tones after which you are to sing, whistle or hum a specified interval above or below each tone as requested. You may respond in a more comfortable vocal register if necessary. Each tone will be played twice.

A. Interval AM3 Tone Ab Response Tone___ Interval ___
B. Interval DP5 Tone D Response Tone___ Interval ___
C. Interval Am2 Tone F# Response Tone___ Interval ___
D. Interval DP4 Tone G Response Tone___ Interval ___
E. Interval Am3 Tone Eb Response Tone___ Interval ___
F. Interval Dm6 Tone F Response Tone___ Interval ___
G. Interval ATT Tone E Response Tone___ Interval ___
H. Interval DM3 Tone C# Response Tone___ Interval ___
I. Interval AM2 Tone Bb Response Tone___ Interval ___
J. Interval DP8 Tone B Response Tone___ Interval ___
III. **Tonic Identification:** You will hear short excerpts of major or minor tonal compositions, after which you are to sing, whistle or hum the tonal center of each composition. You may respond in any octave register

A. Tonal Center ___ Response ___
B. Tonal Center ___ Response ___
C. Tonal Center ___ Response ___
D. Tonal Center ___ Response ___
E. Tonal Center ___ Response ___
F. Tonal Center ___ Response ___
G. Tonal Center ___ Response ___
H. Tonal Center ___ Response ___
I. Tonal Center ___ Response ___
J. Tonal Center ___ Response ___

IV. **Chord Identification:** Sing, whistle or hum the tones of the chords asked for from their root up to their highest member. Each root will be sounded twice and you may respond in a more comfortable register if necessary.

A. C\text{G\_M} Root F Res.:Root ___ Third ___ Fifth ___ Sev. ___
B. C\text{G\_m7} Root Ab Res.:Root ___ Third ___ Fifth ___ Sev. ___
C. C\text{G\_A} Root E Res.:Root ___ Third ___ Fifth ___ Sev. ___
D. C\text{G\_dd} Root C Res.:Root ___ Third ___ Fifth ___ Sev. ___
E. C\text{G\_m} Root Eb Res.:Root ___ Third ___ Fifth ___ Sev. ___
F. C\text{G\_MM} Root A Res.:Root ___ Third ___ Fifth ___ Sev. ___
G. C\text{G\_Mm} Root G Res.:Root ___ Third ___ Fifth ___ Sev. ___
H. C\text{G\_d} Root D Res.:Root ___ Third ___ Fifth ___ Sev. ___
I. CQ dm Root C#  Res.: Root __ Third __ Fifth __ Sev. __
J. CQ mm Root F#  Res.: Root __ Third __ Fifth __ Sev. __

V. Melodic Dictation: Write the melodies heard on the staves provided. The key signature, time signature and first note of each melody are provided also. Each melody will be played four times and preceded by the appropriate number of clicks to establish the meter and tempo.

A.

B.