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THE EFFECT OF A ONE-SEMESTER MUSIC APPRECIATION

COURSE UPON MUSIC PROCESSING STRATEGIES

OF COLLEGE STUDENTS

by

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APPROVAL PAGE

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Several studies have been conducted investigating hemispheric dominance for melodic stimuli of professional musicians. This study was an investigation of the effects of a one-semester music appreciation course on music processing strategies of college students. Twenty-seven students enrolled in a music appreciation class (experimental group) and 27 students from a psychology class (control group) served as subjects. The subjects were matched for musical aptitude.

Two dichotic listening tapes--one of short melodies, the other of spoken consonants--were administered to each subject at the beginning and end of a semester of study. Frequency tabulations of correct scores for each ear were calculated. Double-correct scores, which were correctly identified by both ears simultaneously, were also tabulated. The mean scores for each group were used to determine which ear was dominant in processing examples of the dichotic listening tasks. The significance of difference between pretest and posttest scores were compared by calculating a *t* test for dependent samples.

Subjects showed a right-hemisphere dominance for processing melodic stimuli. After a semester of music appreciation study, there was no shift in hemispheric dominance for processing melodies in the

experimental group. One semester of music appreciation instruction did not produce a shift in laterality to the left hemisphere for processing melodic information.

The range of years of musical experience (defined as private instruction on a musical instrument or participation in a performing group) for subjects varied from 0 to 10 years. Although not statistically significant, as years of musical experience increased, both groups showed a trend toward utilization of left-hemisphere strategies for processing melodic stimuli.

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CHAPTER I

INTRODUCTION

Research involving the two hemispheres of the brain in association with possible applications in specific areas of music education has become prominent among researchers in recent decades. Some researchers have found that musicians process music differently than do individuals who have not had formal music instruction, and others have found no difference in processing strategies as a function of music training. The purpose of this study was to investigate the possible effects of a one-semester college music appreciation course on the way individuals process musical stimuli.

Hemispheric Dominance and Music Processing

The cerebral cortex of the brain is divided into two hemispheres. The left hemisphere has been acknowledged as the primary center for processing verbal and printed stimuli for over a century, but the specializations of the right hemisphere, such as pattern recognition and processing of nonverbal stimuli, are still being confirmed (Galin, 1976). Some researchers (Kimura, 1973; McCarthy, 1969) suggest that the processing of musical stimuli is a function of the right hemisphere.

Kimura (1973), in a summary of her research on hemispheric dominance for different stimuli, supported the premise that the right hemisphere was dominant for processing music. She tested subjects using a dichotic listening procedure in which two different melodic stimuli were presented simultaneously to each ear by means of stereo headphones. When melodic patterns were presented to each ear, subjects correctly selected melodies presented to the left ear more consistently than melodies presented to the right ear. This left-ear dominance for melodic patterns was interpreted by Kimura as a superiority of the right hemisphere for processing music--an assumption based on the following scientifically supported fact: ipsilateral or crossed pathways that connect the ears to the brain are stronger than contralateral or uncrossed connections (Rosenzweig, 1951).

Kimura's theory that music was a function of the right hemisphere was supported by other researchers (Milner, 1962; McCarthy, 1969). As more recent studies were conducted, it became apparent that an individual's musical background and the nature of the musical task were important variables to be considered in determining cerebral dominance for music processing.

In a study using musicians and nonmusicians as subjects, Bever and Chiarello (1974) determined that recognition of a sequence of tones was a function of the right hemisphere for nonmusicians. In their study musicians employed the left hemisphere, suggesting an analytical approach to the same task.

According to Bever and Chiarello, perception of a tonal sequence, a holistic task for inexperienced listeners, becomes an analytical process for those with musical training. They stated that hemispheric dominance could possibly be a function of task requirements rather than stimulus content. Other researchers (Hirshkowitz, Earle, & Paley, 1978; Papcun, Krashen, Terbeek, Remington, & Harshman, 1974; Peretz & Morais, 1980; Schweiger, 1981; Wagner & Hannon, 1981) have concurred with Bever and Chiarello in support of the hypothesis that hemispheric dominance should be attributed to processing strategies rather than stimulus content.

Because music is a complex phenomenon involving elements such as rhythm, melody, harmony, and form, researchers have also been interested in how subjects process these different components of music. This research has been conducted primarily in the last decade and results often have been contradictory. Some researchers have shown rhythm to be a function of the left hemisphere (Halperin, Nachshon & Carmon, 1973; Natale, 1977; Robinson & Solomon, 1974), others believe it is a right-hemisphere process (Shapiro, Grossman, & Gardner, 1981), and a third belief is that rhythm is a bilateral function (Herrick, 1982). In support of the hypothesis that processing of musical stimuli is affected by musical training, researchers (Baumgarte and Franklin, 1981) have found that individuals process rhythm in different hemispheres. According to their research, musicians tend to process rhythms in a holistic manner employing the right hemisphere while nonmusicians employ an analytic strategy involving the left hemisphere.

Gordon (1970, 1975, 1980), in extensive testing of musicians and nonmusicians, found no difference between the two groups for processing musical chords--a right-hemisphere function, according to Gordon. In view of the considerable disagreement among researchers on hemispheric function, the need for additional research in the area becomes obvious (see Chapter II for a thorough discussion of the literature). It is evident that before music educators can apply this research, more knowledge of music learning and how the human brain processes information is necessary.

As researchers study how hemispheric dominance relates to the processing of music, more information that is useful to music educators is revealed. Research has been conducted to test the effects of long-term musical training of professional musicians on hemispheric dominance. In contrast, published literature does not include studies dealing with how a short-term study of music such as a one-semester music appreciation course could affect cerebral dominance for processing music. The present study was designed to investigate this question.

Teaching Music Appreciation

Reimer (1970) stated that music educators have a dual obligation to society. "The first is to develop the talents of those who are gifted musically . . . the second obligation is to develop the aesthetic sensitivity to music of all people regardless of their individual levels of musical talent" (p. 112). The teaching of music appreciation is one means of achieving the second obligation and may have an indirect relationship to the first.

In the early 1900's the term "music appreciation" was used in music textbooks and identified with the study of music through listening lessons (Birge, 1928). Since that time, music appreciation courses have generally been included as part of liberal arts education. They are usually one-semester courses and often represent the only encounter a majority of students have with formal music instruction in higher education.

The teaching of music appreciation courses is idiosyncratic. Colwell (1961) stated that there was no basis for the content taught in music appreciation courses and that apparently no universal method of teaching a music appreciation course existed.

Operational Definition. The lack of educational standardization which Colwell described is evident in the confusion of terms used in college music appreciation courses. Hoover (1974) compiled the results of experimental research related to music listening instruction and found that a disparity existed in the titles of music appreciation courses. The use of terms such as "discrimination," "structure," "appreciation," "attitude," and "value" was often misleading.

For the purposes of this study, "music appreciation" will be defined as a course in a formal educational environment in which the primary objective is to strengthen students' abilities to value music through (1) pedagogical techniques directed toward improving listening skills, (2) developing an understanding of the elements of music and how they are related, and (3) increasing the knowledge of musical form and styles of composition. With these skills as a foundation, perhaps students will be able to enhance their aesthetic responses to music and continue to develop as music listeners.

Development of Listening Skills

Because music is an aural art, the teaching of music appreciation inherently involves instructional procedures directed toward the development of students' listening skills. If listening skills can be taught, it is logical to assume that the teaching of listening skills should be founded on educational principles. Mueller (1956) stated that learning to listen is more of a science than an art and should be developed gradually in four steps:

> (1) learning to perceive the details of rhythm, harmony, and form, (2) giving names to the perceptions, (3) building these percepts into more complex and well-defined wholes (concepts), and (4) using these concepts as the framework for comprehending new musical experiences (p. 17).

Mueller has described a process involving an analytic and holistic approach to learning to listen, which are separate functions of the two hemispheres of the brain. Information concerning how individuals process musical stimuli could be of great value in structuring a course in learning to listen to music.

Questions to be Investigated

From the previous discussion, it is obvious that the cerebral processing of music is a complicated phenomenon. Researchers have found that the different components of music involve separate processing strategies of both hemispheres of the brain. Some studies of the cerebral dominance of musicians have indicated that professional musicians employ different means of processing music than do subjects who have not studied music extensively.

In higher education, a music appreciation course usually represents one semester of instruction in music. Does a one-semester course alter listeners' strategies for processing music? Do students who have completed a music appreciation course use left-hemisphere strategies for processing music? (Some research has shown that professional musicians employ such strategies.) Do some people use these strategies regardless of training? Information leading to answers to these and similar questions would undoubtedly be of value to teachers of music appreciation.

In accordance with the purpose of this study, the research questions were as follows:

1. Do college students who have completed a one-semester music appreciation course process musical stimuli, as measured by a dichotic listening task, differently than do students who have never formally studied music appreciation?

2. Are college students who have completed a one-semester music appreciation course more efficient in processing musical stimuli, as measured by identifying both left- and right-ear stimuli on a dichotic listening task, than are students who have never formally studied music appreciation?

3. Does a one-semester college music appreciation course alter the hemisphere in which students process musical stimuli?

More information needs to be obtained about the analytic and holistic nature of music learning tasks. Such knowledge could benefit music educators in constructing new methods of teaching music listening.

CHAPTER II

RELATED LITERATURE

History of Music Appreciation Courses

Music appreciation courses were founded in the need for listening guides for concert patrons in America in the first half of the nineteenth century. In 1826 the Swiss educator, Nageli, published one of the first treatises written for "amateur listeners." Other European and American educators--Prentice, Mathews, Prescott, and Krehbiel--contributed to this literature in the latter part of the century (Scholes, 1935).

In 1904, music was recognized by the National Education Association (NEA) as a course in scholastic curricula for which academic credit was granted. As a result of this action, music examinations were offered as part of the College Entrance Examination Board tests in 1907 (Tellstrom, 1971). Subsequently, music appreciation courses began to appear in curricula at high school and college levels. Birge (1926) commented on this trend in music education.

> The term appreciation, applied to music both in the broad sense of a ruling purpose in school music and the more restricted sense of a curriculum subject, came into use in the present century. It is conspicuously absent from the discussions and writings of school music teachers during the preceding epochs. It began to be used at the beginning of the present century to express a broadening conception of what the aim of public school music should be, and about a decade later it became thoroughly identified with studying music by means of listening lessons (p. 205).

People who were leaders in establishing music appreciation courses in schools during the first part of the twentieth century were Earhart, Dykema, Regal, Clark, Surrette, Mason, and Damrosch (Scholes, 1935).

Studies in Music Appreciation

The development of listening skills. Hoover (1974), in a review of experimental research related to music listening (from 1934 to 1972), concluded that listening skills can be learned. He stated that discrimination skills of performance quality, style characteristics, and formal structure can be acquired by students as early as the seventh grade. According to Hoover, little relationship existed between listening skills or affective response and sex, I.Q., socioeconomic status, or previous musical experiences. Students with limited musical experiences or from lowest socioeconomic status exhibited the greatest improvement in listening skills. Although students with extensive musical backgrounds were more successful in tests of discrimination than other students, the difference in average scores was not statistically significant.

Porter (1965) conducted a study to identify musical experiences of students in music appreciation classes. He found that students with musical training and previous experiences in performance organizations exhibited a "lack of understanding" of musical concepts. Similar findings were supported by the research of Eisman (1975) and Haack (1966).

Eisman compared two methods of teaching perceptive listening skills at the college level. A traditional lecture-demonstration approach was taught in one class and a problem-solving approach in another class. Eisman concluded that students' music reading skills were not a factor in improvement of music listening skills.

Haack conducted a similar experiment at the secondary school level by testing students' listening skills of discriminating thematic development in musical compositions. One method of teaching involved a deductive, analytical approach to listening. The other method was inductive, based on the synthetic treatment of melodic materials. Haack concluded that an understanding of melodic relationships in thematic developments of music was not improved as a result of previous musical experiences of junior high and high school students, regardless of the method of instruction.

Cahn (1960) conducted a survey to identify problems of music appreciation teaching as perceived by students and teachers in northern California colleges and junior colleges. According to the responses, there was disagreement between students and teachers concerning skills of music appreciation teachers. Students identified the following behaviors of effective teachers: the presentation of pedagogical content in a slowly paced and sequential manner, the limited use of technical terms, the use of nonmusical information (such as biographical data of composers' lives) in class presentations, the use of a variety of musical examples, the effective use of audiovisual aids, and the frequent use of repetition and review. Teachers interviewed in Cahn's research also identified selection of music and presentation of material as problems of teaching.

Effect of methodology on music appreciation learning. In an experiment in music appreciation, Keston (1954) compared two methods of teaching music appreciation. In a control group, students listened to musical compositions without any presentation of information about the musical examples. Students in the experimental class listened to the same musical compositions; however, relevant facts about the music were also presented. The organization of recorded material in both groups was chronological. The experimental method of instruction, which included discussions and presentation of relevant information concerning the musical examples, was significantly more effective than the control method.

Smith (1980) conducted an experiment to compare two approaches to teaching music appreciation at the college level. The two approaches were based on the use of two music appreciation texts: _The Art of Listening_ by Bamberger and Brofsky (experimental group), and _The Enjoyment of Music_ by Machlis (control group). The format for _The Art of Listening_ is conceptual; information is presented according to the elements of music. In _The Enjoyment of Music_, the material is grouped in units according to period of composition. The order of presentation of periods, however, is not chronological. The use of the Machlis text was found to be more effective than the experimental approach in developing musical listening skills and aesthetic judgment.

In contrast, in the research of Haack (1966) and Eisman (1975) cited previously, methodology was not found to be a factor in the effectiveness of teaching music listening. Both researchers compared two methods of teaching and concluded that neither approach was superior in the development of listening skills.

Smith (1969) conducted a study to determine the listening skills of college students in discriminating among musical forms and style in compositions. All subjects were enrolled in a one-semester college music appreciation class. Students' progress in the ability to identify the formal structure of unfamiliar compositions was not significant. Smith recommended that teaching musical form be relegated to a minor role in music appreciation courses. If teaching form is maintained as a major objective in music appreciation courses, Smith indicated the need for more precise delineations of distinguishing characteristics of each era of compositions.

Published literature concerning the effects of a one-semester music appreciation course upon students' cerebral processing of music is not available. Studies relevant to the present research are discussed below.

History of Brain Hemisphere Research

The brain of humans is divided into two hemispheres, connected by a band of nerve tissue called the corpus callosum. In the early 1950's scientists discovered that when the corpus callosum was severed, thus separating the right and left hemispheres of the brain, each hemisphere functioned independently (Gazzaniga, 1967). In clinical research with patients requiring surgical severance of the corpus callosum, scientists have been able to study how the two hemispheres of the brain differ in function.

From this research scientists have determined that both sides of the brain are involved in information processing in varying degrees, with each hemisphere dominant for certain functions (Zangwill, 1967). Dimond and Beaumont (1974) have indicated a left-hemisphere dominance for speech and language, complex motor functions, and paired-associative learning. The right hemisphere has been found to be dominant for spatial integration, calculation, and creative-associative thinking. Neither hemisphere dominates for simple motor responses, incidental learning, or fatigue processes. Ornstein and Galin (1976) have hypothesized that the nondominant hemisphere is suppressed or "turned off" by the dominant hemisphere when processing a specific task. The researchers stated that both hemispheres are involved, but EEG activity showed a larger alpha rhythm in the nondominant hemisphere.

Dichotic listening technique. Hemisphere research was extended to test normal subjects through the development of a dichotic listening technique devised by Broadbent (1954). The human nervous system is constructed so that each cerebral hemisphere receives information primarily from the opposite side of the body. The visual, tactual, and motor systems of the brain are almost completely crossed. The auditory system is somewhat less crossed, in that each hemisphere receives input from both ears, but the crossed connections are stronger than the uncrossed ones (Rosenzweig, 1951).

Broadbent's dichotic listening technique involved simultaneously presenting a spoken digit to one ear and a different spoken digit to the other ear. Three pairs of digits were used in each trial and the subject was asked to report all the numbers heard. Subjects reported the numbers they had heard more accurately with the right ear than with the left. Because crossed pathways to the brain are stronger than uncrossed connections (Rosenzweig, 1951), it was determined that subjects were employing the left hemisphere (right ear) for this task. Broadbent tested patients with temporal damage to the brain as well as normal subjects, and obtained the same results.

Since Broadbent's time, researchers have accepted the dichotic listening technique as an appropriate measure of hemispheric dominance. Other researchers have devised listening tasks to include pairs of words, nonsense syllables, vowels, consonants, and melodies (Kimura, 1973).

Dichotic Listening Studies

Studies (Kimura, 1961a; Kimura, 1961b) using the dichotic listening technique have compared normal subjects with unoperated epileptic patients. Both reported a left-hemisphere dominance for speech.

Other studies were conducted to test the hypothesis that when subjects hear dichotically presented material, they identify stimuli from one ear before identifying stimuli presented to the other (known as the ear order effect). Researchers (Broadbent & Gregory, 1964; Satz, 1968) devised an experiment using dichotic presentation of information in which stimuli were presented at slightly different intervals in time. This control did not produce a change in ear dominance for verbal stimuli, thereby supporting the theory that stimuli arriving at the dominant hemisphere are more readily perceived than are stimuli arriving at the nondominant hemisphere.

In initial studies utilizing the dichotic listening technique, subjects were asked to respond by verbally relating the digits that were heard in each ear. For example, input to right ear would include the numbers 3, 5, 7 and the left ear, the numbers 4, 2, 1. The subject might respond by recalling 3, 7, 1. Two correct answers would be recorded for the right ear and one, for the left ear. Researchers challenging this method argued that recall or memory was being tested as well as cerebral dominance. Additional studies were conducted (Broadbent & Gregory, 1964; Satz, 1968) in which subjects were asked to identify groups of digits rather than recalling the digits that were heard. A sample trial is presented in Figure 1.

Right ear only		483				
Both ears	Trial I		483	403	039	038
Left ear only		039				
	Sequence	1	2	3	4	5

Figure 1--Digits presented in a Dichotic Listening Experiment

Both experiments showed no change in hemispheric dominance as a result of design.

In an extensive review of the literature on hemisphere research, Bryden (1967) supported Kimura's theory that stimuli arriving at the dominant hemisphere are more readily perceived than is material arriving at the nondominant hemisphere (regardless of how the stimuli are tested and recorded).

Another test of the dichotic listening technique (Dirks, 1964) was conducted comparing recognition of verbal material in dichotic and monaural presentations. Dirks found that when stimuli were presented monaurally to subjects, discrimination scores were almost identical for each ear. He supported the dichotic technique as a viable procedure to test cerebral dominance.

Dichotic Listening Studies Involving Musical Stimuli

Milner (1962) conducted an experiment on auditory discrimination using patients with right or left temporal-lobe lesions. Subjects were tested using the Seashore Measures of Musical Talents (1939 edition) before and after surgery to remove lesions from the brain. Pre- and postoperative scores were not significantly changed for any patients on the time, rhythm, or pitch subtests of the Seashore test. Patients with right temporal lobectomies showed significant increases in error scores on the loudness (t=2.38, $p<.05$), timbre (t=3.84, $p<.01$), and tonal memory (t=3.39, $p<.01$) sub-tests. This was not true of patients following left temporal surgery. Milner's experiment was one of the first clinical tests of right-hemisphere involvement in auditory discrimination.

Kimura (1964) conducted an experiment using the dichotic listening technique with two different tasks: one using spoken digits, the other using melodies. Two melodies were presented simultaneously, followed by four melodies which included the previously heard dichotic examples. Subjects verbally identified the melodies that were heard in the dichotically presented examples. Subjects showed a significant left-hemisphere dominance ($p<.02$) for the digits task and a right-hemisphere dominance ($p<.01$) for the melodies task.

McCarthy (1969) conducted a similar dichotic listening experiment using two different tasks: one requiring identification of spoken digits, the other requiring identification of paired tones. The right hemisphere was dominant in tonal recognition and the left hemisphere in digit recognition.

In a summary of her previous work utilizing dichotic listening tapes, Kimura (1973) stated that subjects showed a left-hemisphere dominance for processing nonsense syllables and nonsensical words but showed a right-hemisphere superiority for recognition of words and letters. After simultaneous dichotic presentation of melodies, subjects "usually" showed a right-hemisphere dominance for perception of melodic stimuli.

Hemisphere Research using Musicians as Subjects

In 1974, Bever and Chiarello conducted an experiment using experienced listeners (individuals who had had at least four years of private music lessons and were currently playing or singing) and inexperienced listeners (individuals who had had less than three years of private lessons, at least five years prior to the study). Prior to this time, no experiments testing differences in processing strategies of musically experienced and musically inexperienced subjects had been published.

Seventy-two sequences, each containing 12 to 18 tones, were presented to the subjects, half of the sequences presented to the right ear and half to the left. Each sequence was followed by a two-tone excerpt. Subjects indicated whether the excerpt was contained in the sequence and whether the entire sequence was heard previously. Musically experienced subjects showed a left-hemisphere dominance for melody recognition, and musically inexperienced subjects showed a right- hemisphere dominance. Only the experienced listeners could recognize whether the entire excerpt was part of the previous sequence. Bever and Chiarello concluded that perception of a tonal sequence, a holistic task for inexperienced listeners, becomes an analytic task resulting from musical training. Therefore, they stated that hemispheric dominance could possibly be a function of task requirements rather than stimulus content.

A similar experiment testing hemispheric specialization was conducted by Papcun et al (1974). They presented Morse code signals dichotically to experienced Morse code operators and to subjects ignorant of Morse code. Experienced operators employed a left-hemisphere strategy while naive subjects processed the information with the right hemisphere.

Hirshkowitz, Earle, and Paley (1978) presented verbal and musical stimuli to musicians and nonmusicians and recorded EEG readings of each hemisphere. The right hemisphere was more active than the left when nonmusicians listened to musical stimuli. For musicians, this relationship between neural activation of the right hemisphere and musical stimuli was not found. The researchers concluded that differences between groups of subjects was attributed to processing strategies rather than stimulus content.

Wagner and Hannon (1981) tested musicians and nonmusicians for melody recognition. They found a left-hemisphere dominance for musicians and a right-hemisphere advantage for nonmusicians. In a similar experiment, Schweiger (1981) tested musicians and nonmusicians for melodic recognition using excerpts from chorales by J. S. Bach. Each passage was presented dichotically, followed by four excerpts: the soprano line, the bass line, entire chorale, or the harmonic progression. Both musicians and nonmusicians showed right-hemisphere involvement in recognizing the soprano line, but only the musicians showed left-hemisphere processing for the other recognition tasks. As part of the treatment, the nonmusicians were divided into two groups: one group received four one-hour sessions in ear training, the other group, four hours of listening to popular music. Neither treatment produced a shift in laterality for nonmusicians.

Peretz and Morais (1980) tested nonmusicians for hemispheric dominance using melodic stimuli. Although no significant dominance was found, when subjects were instructed to listen carefully for distinct characteristics of the melodic patterns, a left-hemisphere strategy of processing was found. The researchers concluded that left-hemisphere involvement in melody recognition does not necessarily require formal musical training.

Hemisphere Research Involving Different Components of Music

Experiments have been conducted testing hemisphere laterality for different components of music. Baumgarte and Franklin (1981) used dichotic listening methodology to test musicians and nonmusicians on four tasks: melodies, tonal patterns, rhythm patterns, and verbal stimuli. The only lateralization difference observed was for rhythm pattern recognition, for which musicians showed right-hemisphere superiority as contrasted with left-hemisphere dominance for nonmusicians.

In an experiment studying the effects of sung speech on lateral dominance, Bartholomeus (1972) used musicians as subjects. The required tasks were melody, letter, and singer recognition. There was no significant effect on laterality using the singer recognition task. A significant left-hemisphere superiority for letter sequence recognition was found as was a significant right-hemisphere involvement for melody recognition. These findings provide further support for the assertion that hemisphere laterality is not solely determined by the type of stimulus but is also dependent on task requirements. Mayo (1979) conducted a similar experiment and found that hemispheric processing of sung stimuli was dependent upon the complexity of the stimulus. There was no effect on hemisphere laterality as a result of musical training.

Henninger (1982) tested hemispheric dominance for a complex musical task using musicians and nonmusicians as subjects. When attempting to identify a transposed melody, it was found that musicians processed tonality with the left hemisphere whereas nonmusicians processed tonality with the right hemisphere. A musical aptitude test was administered to all subjects, and no significant correlation was found between musical aptitude and hemispheric dominance.

Degree of dominance in tonal processing was investigated by Rushford-Murray (1977). Musicians listened to attack transient, steady-state, and legato transient segments of clarinet, violin, oboe, trumpet, piano, and flute tones in one ear while white noise was presented simultaneously to the opposite ear. Attack transients were identified correctly more often when presented to the right ear. Steady-state conditions were identified with equal accuracy in both ears. The legato transient segments were identified correctly more often from the left ear presentations.

Gordon (1970) tested members of performing musical organizations using three dichotic tasks: digits, melody recognition, and chord recognition. He found that a right-hemisphere strategy was used in processing the chordal task but neither hemisphere exhibited a superior dominance for melodies. This contradicts other findings for melodic processing. In subsequent research (1975, 1980), Gordon concluded that there are some individuals, regardless of training, who are more capable of using the left hemisphere and who perform well on time-ordering, sequential analysis tasks. Gordon conducted six experiments using 368 professional and amateur musicians. Right-hemisphere superiority for perception of dichotically presented musical chords was seen in subjects of all levels of competence. However, an hypothesis that dominance would be greater in professional musicians was not confirmed.

Aiello (1978) tested cerebral dominance for the perception of arpeggiated triads that differed in tonality and pattern. Subjects were musical and nonmusical adults and children. The nonmusicial adults showed a left-hemisphere dominance for the triad pattern task, suggesting an analytical strategy. It was reported that both nonmusical adults and children employed the right hemisphere for the perception of triads differing in tonality and pattern, employing holistic procedures for this task. Musically trained adults and children showed no significant lateral dominance for any of the tasks.

There is controversy about which side of the brain is responsible for processing rhythmic information. Some researchers believe rhythm or time-ordered stimuli are a function of the left hemisphere (Halperin, Nachshon, & Carmon, 1973; Natale, 1977; Robinson & Solomon, 1974), others believe it is a right-hemisphere process (Baumgarte & Franklin, 1981; Shapiro, Grossman, & Gardner, 1981), and a third philosophy hypothesizes that rhythm is a bilateral function (Herrick, 1982).

Verbal information is generally believed to be processed in the left hemisphere. Since one of the important features of verbal material is its sequential character, it might be assumed that nonverbal but sequentially patterned sounds will be mediated by the left hemisphere. Halperin, Nachshon, and Carmon (1973) presented two dichotic listening tasks to subjects. They were instructed to identify sets of sounds differing in sequential complexity of frequency or of duration. The results showed that as the temporal patterns became more complex, subjects processed the stimuli in the left hemisphere.

Robinson and Solomon (1974) presented short rhythmic phrases dichotically to subjects. The duration of the individual pulses within the rhythm patterns were designed to be similar to spoken syllable durations. It was reported that subjects processed these patterns in the left hemisphere. Natale (1977), in a similar experiment involving dichotic presentation of rhythmic stimuli, found the same results for rhythmic processing. More complex rhythms elicited greater left-hemisphere perceptual preference.

In an experiment involving brain-damaged patients, Shapiro, Grossman, and Gardner (1981) found that subjects with damage to the right side of the brain experienced difficulty in the detection of rhythmic stimuli. Subjects with left-hemisphere damage performed well on this task. The results of this clinical study suggest that the right hemisphere is involved in processing rhythm.

Baumgarte and Franklin (1981) tested musicians and nonmusicians for rhythmic processing using dichotically presented stimuli. Musicians showed a right-hemisphere dominance for processing rhythms, while nonmusicians showed a left-hemisphere superiority. The musicians apparently perceived rhythms primarily in terms of patterns, whereas the nonmusicians found it necessary to approach the task in a more analytic manner.

Herrick (1982) investigated hemispheric specialization for the pitch and rhythmic aspects of melody. She tested musicians and nonmusicians and found that musicians exhibited a right-hemisphere dominance for pitch; however, neither group showed a hemispheric superiority for processing rhythm. Herrick concluded that rhythm was a bihemispheric specialization.

Handedness and Cerebral Dominance

It is generally believed that handedness and cerebral dominance are integrally related. For the majority of hemisphere research cited previously, subjects who participated in the experiments were right-handed. Soon after it was first proposed that the left hemisphere had a special role in language, it became obvious that non-right-handers (that is, left-handed and ambidextrous persons) had to be considered separately. Not only do they often differ from right-handers, they differ substantially among themselves (Deutsch, 1975).

Curry (1967) conducted a study comparing left- and right-handed subjects on verbal and nonverbal dichotic listening tasks. Comparison of the two groups on each of the tasks revealed that left-handed subjects processed information in a different hemisphere than right-handed subjects. There were also more left-handed subjects who changed hemispheric dominance within the testing procedure, displaying a bilateral dominance.

Nebes (1971) tested right- and left-handed subjects for the ability to perceive part-whole relationships. Subjects tactually examined an arc and then visually selected the size of a complete circle from which that arc had come. Left-handers were found to be significantly deficient, compared to right-handers on this task. Nebes concluded that since this task has been found to be a function of the nondominant hemisphere, functions of this hemisphere are not as efficiently organized in left-handers as they are in right-handers.

In a study involving the perception of auditory illusions, Deutsch (1975) found that right- and left-handed subjects perceive the illusions differently. She dichotically presented a "high" tone in one ear and a "low" tone in the other ear. When headphones were reversed most subjects experienced the same aural sensation. Right-handed subjects perceived the high tone with their right ear and the low tone with their left ear and maintained this percept when the earphones were reversed. Left-handed subjects were just as likely to localize the high tone in their left ear as in their right. Deutsch suggested that in left-handed subjects either hemisphere may be dominant.

Reliability of Dichotic Listening Procedure

The dichotic listening technique, originally introduced by Broadbent (1954), has become one of the most widely used methods for assessing right- or left-hemispheric dominance for different kinds of materials. Several studies have been conducted to test the reliability of this procedure.

Pizzamiglio, Pascalis, and Vignati (1974) used a digits task presented dichotically to right-handed subjects. They were individually tested twice, with one month between the two tests. The test-retest correlation was significant ($p<.01$) with the ear preferences of the subjects the same on the retest in 70% of the observations. Thirty percent of the subjects reversed their ear preferences on the second test.

In a similar study, Fennell, Bowers, and Satz (1977) tested subjects four times, with a week separating each test administration, using the same word task presented dichotically for each testing period. Pearson product-moment correlations for each ear on the four tests ranged from .74 to .90.

Blumstein, Goodglass, and Tartter (1975) conducted a reliability study of dichotic listening performance on consonants, vowels, and music. Each subject was tested twice on all three tasks, with the second session held at least one week after the first. Pearson product-moment correlations between ear scores on the first and second tests were .74 for consonants, .21 for vowels, and .46 for music. Twenty-nine percent of the subjects reversed ear advantage for consonants on retesting, 19% reversed for music, and 46% for vowels. Each type of stimulus revealed a significant subgroup that retained an ear advantage other than the expected norm. The researchers concluded that in any sample, subjects whose ear advantage scores are other than expected are more likely to reverse ear advantage scores on retest than are subjects who score in the modal direction.

Seashore Measures of Musical Talents

The Seashore Measures of Musical Talents (1960 Revision) was administered in the initial stages of this study for the purpose of matching the two groups according to musical aptitude. In the test manual Seashore uses the terms--talent, capacity and aptitude--interchangeably. The researcher used this test as a measure of aptitude. The test consists of six subtests: pitch, loudness, rhythm, time, timbre, and tonal memory.

Reliability coefficients reported in the test manual were computed by means of internal consistency coefficients (Kuder-Richardson formula 21). They are reported in Table 1.

Table 1

Coefficients of Reliability

Subtests	Grades 9-16
Pitch	.84
Loudness	.74
Rhythm	.64
Time	.71
Timbre	.68
Tonal Memory	.83

In the test manual, Seashore stated that the test is valid by the very nature of its construction and reports no statistical estimates of validity. He cited several sources in the bibliography (Bienstock, 1942; Lundin, 1953; Farnum, 1950, 1953) which present summaries of validation studies where scores on the Measures of Musical Talents are correlated with external criteria.

Summary

A summary of literature relating to the history of music appreciation courses is presented in the following statements.

1. (Scholes, 1935; Tellstrom, 1971) Nineteenth century educators wrote listening guides for concert patrons.

2. (Birge, 1926) Music appreciation courses became part of college and high school curricula.

Based on the studies cited in this chapter, a summary of the factors contributing to development of listening skills in music appreciation courses is as follows:

1. (Hoover, 1974) Listening skills can be learned.

2. (Eisman, 1975; Haack, 1966; Hoover, 1974; Porter, 1965) Sex, I.Q., socioeconomic status, and previous musical experience are not contributors to developing listening skills.

3. (Cahn, 1960) Effective teaching is a factor in the development of listening skills.

4. (Keston, 1954) Presentations which include music listening accompanied by verbal information relevant to the music are more effective than ones in which music is heard without explanation.

5. (Smith, 1980) The use of The Enjoyment of Music text is more effective in developing musical listening skills and aesthetic judgment than the use of The Art of Listening text.

6. (Eisman, 1975; Haack, 1966) Methodology might not be a determining factor in the development of listening skills.

7. (Smith, 1969) Formal structure in music is difficult to teach in music appreciation courses and should be relegated to a minor role.

Brain hemisphere research began in the 1950's; a summary is presented below.

1. (Gazzaniga, 1967; Zangwill, 1967) The human brain is divided into two hemispheres with each hemisphere dominant for certain functions.

2. (Dimond and Beaumont, 1974) The left hemisphere is dominant for language, complex motor functions, and paired-associative learning. The right hemisphere is dominant for spatial integration, calculation, and creative-associative thinking.

3. (Ornstein and Galin, 1976) The non-dominant hemisphere is suppressed by the dominant hemisphere in processing tasks.

4. (Broadbent, 1954) The dichotic listening technique was developed by Broadbent.

5. (Rosenzweig, 1951) Crossed connections in the brain are stronger than uncrossed ones.

6. (Kimura, 1973) The dichotic listening technique has been used with a variety of stimuli.

Studies were conducted using dichotic techniques with normal and brain-damaged subjects.

1. (Kimura, 1961a; 1961b) Kimura used the dichotic listening technique with "normal" subjects and with epileptic patients. She found that both groups processed speech in the left hemisphere.

2. (Broadbent & Gregory, 1964; Satz, 1968) Researchers tested ear order effect.

3. (Broadbent & Gregory, 1964; Satz, 1968) Researchers showed that subjects can either respond verbally to dichotically presented stimuli or by recognizing visually what is being heard. No change in hemisphere dominance was evident.

4. (Bryden, 1967) The researcher indicated that stimuli arriving at the dominant hemisphere are more readily perceived than stimuli to the nondominant hemisphere.

5. (Dirks, 1964) The researcher found that presenting stimuli monaurally revealed few discrimination behaviors for measuring hemispheric dominance.

Dichotic listening studies were devised to include musical stimuli. A summary of these studies follows:

1. (Milner, 1962) Milner's study was the first clinical study to relate music processing to right-hemisphere processing.

2. (Kimura, 1964) The researcher tested subjects dichotically using melodic stimuli and found a right-hemisphere dominance for music.

3. (McCarthy, 1969) In a similar experiment, the researcher found that subjects recognized pairs of tones with the right hemisphere.

4. (Kimura, 1973) The researcher summarized previous work and stated that subjects usually showed a right-hemisphere dominance for processing melodic stimuli.

Several studies have been conducted to determine whether musicians and nonmusicians process musical stimuli differently:

1. (Bever and Chiarello, 1974) Researchers found that musicians showed a left-hemisphere dominance for melody recognition and nonmusicians showed a right-hemisphere superiority for the same task.

2. (Papcun, Krashen, Terbeek, Remington, & Harshman, 1974) Subjects experienced in knowledge of Morse code showed left-hemisphere strategy while subjects who were not proficient in Morse code employed the right hemisphere. Hemispheric processing might be a function of task requirements rather than stimulus.

3. (Hirshkowitz, Earle, & Paley, 1978) Researchers tested musicians and nonmusicians and found that differences between groups were attributable to processing strategies rather than stimulus content.

4. (Wagner & Hannon, 1981) Researchers found a left-hemisphere dominance in melody recognition for musicians and right-hemisphere dominance for non-musicians.

5. (Schweiger, 1981) Musicians and nonmusicians listened to Bach chorales. Both showed right-hemisphere dominance for processing a soprano line but only musicians showed left-hemisphere processing for a bass line, entire chorale, and harmonic progressions. Four hours of ear training for non-musicians produced no change in effect.

6. (Peretz & Morais, 1980) In testing nonmusicians for melody recognition, researchers concluded that left-hemisphere involvement does not necessarily require formal training.

There have been studies that examined which is the dominant hemisphere for processing different components of music. Following is a summary:

1. (Baumgarte & Franklin, 1981) Researchers found that musicians showed right-hemisphere superiority for rhythm as contrasted with left-hemisphere involvement for nonmusicians.

2. (Bartholomeus, 1974) Musicians were tested on recognition of melody, singer, and letters. No effect on laterality was found in recognition of sung voices, but left-hemisphere dominance was evident for letter recognition and right-hemisphere superiority for melody.

3. (Mayo, 1979) The researcher conducted a similar experiment and found that hemispheric processing of sung stimuli was dependent upon the complexity of the stimulus.

4. (Henninger, 1982) Musicians and nonmusicians were asked to identify transposed melodies. It was found that musicians processed tonality with the left hemisphere whereas nonmusicians processed tonality with the right hemisphere.

5. (Rushford-Murray, 1977) Musicians listened to tones of various musical instruments. They identified attack transients more efficiently with the left hemisphere; steady states, bilaterally and legato transient segments with the right hemisphere.

6. (Gordon, 1970, 1975, 1980) It was found that musicians and nonmusicians process chordal recognition with the right hemisphere.

7. (Aiello, 1978) Nonmusicians show a left-hemisphere dominance for processing arpeggiated triad patterns. When identifying triads that differ in tonality, they shift to a right-hemisphere strategy.

8. (Halperin, Nachshon, & Carmon, 1973; Natale, 1977; Robinson & Solomon, 1974) Researchers found that rhythm and other time-ordered stimuli are functions of the left hemisphere.

9. (Baumgarte & Franklin, 1981) Researchers found that rhythm is processed in the right hemisphere for musicians and in the left hemisphere for non-musicians.

10. (Shapiro, Grossman, & Gardner, 1981) Researchers found that rhythm is processed in the right hemisphere.

11. (Herrick, 1982) The researcher found that rhythm is processed in both hemispheres.

Several studies have been cited concerning the effects of cerebral dominance on handedness.

1. (Curry, 1967; Deutsch, 1975; Nebes, 1971) Left-handed and ambidextrous subjects process information differently than do right-handers and are usually not included as subjects in hemisphere research.

The reliability of the dichotic listening procedure has been tested by several researchers and is included in this review.

1. (Blumstein, Goodglass, & Tartter, 1975; Fennell, Bowers, & Satz, 1977; Pizzamiglio, Pascalis, & Vignati, 1974) The dichotic listening procedure has been found to be a fairly reliable measure of hemisphere dominance.

Null Hypotheses

The following null hypotheses were formulated for this study.

1. There is no significant ($p=.05$) difference between the mean ear difference scores for pretests and posttests, as measured by a dichotic listening task using melodic stimuli, of students enrolled in a music appreciation class and students in a psychology class.

2. There is no significant ($p=.05$) increase in mean double-correct scores, as measured by a dichotic listening task, of students enrolled in a one-semester music appreciation course.

3. There is no significant ($p=.05$) shift in ear dominance for melodic stimuli, as measured by a dichotic listening task, of students enrolled in a one-semester music appreciation course.

CHAPTER III

PROCEDURE

This study was an investigation of an hypothesis that a one-semester music appreciation course might alter the hemispheric location in which students process musical stimuli. Some researchers (Bever & Chiarello, 1974) have found evidence that musicians show a left-hemisphere function for certain types of musical stimuli while nonmusicians process the same information primarily with the right hemisphere.

Subjects

Participating in this study were 77 freshmen and sophomores from Winthrop College in Rock Hill, South Carolina. Of these students, 31 were enrolled in a one-semester music appreciation course and 46 were enrolled in a one-semester introduction to psychology course. From each group 28 students were chosen to serve as subjects. Before the testing procedure began, the 1960 edition of the Seashore Measures of Musical Talents (MMT) was administered to ensure that the two groups were matched for musical aptitude, as defined by Seashore. At the same time the MMT was administered, each subject was asked to complete a questionnaire to determine previous musical experience, handedness, and any known hearing deficiences. Based on the following criteria, 28 students from each class were selected to serve as subjects.

Criteria for Subject Selection

Handedness. All subjects selected to participate in the study were right-handed. Handedness was determined by students' responses to questions concerning which hand was used in performing simple tasks (see Appendix). A subject who performed 90% of these tasks with the right hand was considered for this study.

Hearing. All students selected to serve as subjects had normal hearing as determined by the results of an audiometer test administered during the two years immediately preceding the study. A pure-tone audiometric screening test is administered to all students entering Winthrop College as education majors. According to the American National Standards Institute (ANSI) and the American Speech and Hearing Association (ASHA), the zone of normal hearing in pure-tone audiometry includes hearing threshold levels for speech from 0-25 decibels (Davis & Silverman, 1978). After administration of the test, students were notified of the results. Anyone whose threshold of hearing was higher than 25 decibels was recalled for further evaluation. In the questionnaire used in this experiment, students were asked if their hearing was evaluated as normal, and anyone with hearing deficiences was not considered for this study. Selection of subjects is described in a later section.

Test description. The MMT consists of six subtests designed to measure musical talent: pitch, loudness, rhythm, time, timbre, and tonal memory. In the pitch subtest, 50 pairs of tones are presented and the subject determines whether the second tone is higher or lower than the first. The same number and type of trials are required on the loudness, time, and timbre subtests. There are 30 trials each in the rhythm and tonal memory subtests. The format of the rhythm subtest is similar to that of the preceding subtests, but the tonal memory subtest format has been changed slightly. A short series of tones are presented and followed by a similar sequence, wherein the frequency of one of the tones of each series has been changed. Subjects are asked to determine which tone is changed in the series of tones.

In the test manual, Seashore stated that many capacities are required for success in music; therefore, he did not provide a composite score for the total set of six subtests. Instead, he encouraged the use of scores from several of the subtests in determining aptitude. A survey of a panel of experts (music faculty members at Winthrop College) was conducted and it was determined that for the purposes of this study, rhythm and tonal memory scores were appropriate indicators of musical aptitude. An average of these two scores was computed for each subject to form a single composite score.

Sample structure

From the 31 music appreciation students (MA), 28 met the criteria for selection. The MA students were divided into four subgroups of seven students, according to their composite scores on the MMT.

Of the 46 students in the psychology course (PSY), 34 met the criteria for selection. In order to have an equal number of subjects in the control and experimental groups, the scores on the MMT served as indices for matching the two groups. Subjects from the PSY group whose scores were within the ranges of the four MA subgroups were identified. In subgroups where there were more than seven students, the researcher randomly selected seven participants to serve as subjects. At the end of the semester when the second set of tests was administered, one subject from each group was eliminated from the experiment due to illness. From each group 27 subjects completed the experiment.

For the 54 subjects who participated in this study, ages ranged from 18 to 22 years with the mean age of the MA group equal to 19.03 and that of the PSY group, 18.8. In the MA group there were one male and 26 female subjects. Five males and 22 females served as subjects in the PSY group. The number of years of musical experience differed for the two groups and is reported in Table 2. Musical experiences included participation in performing groups as well as formal musical instruction (see Appendix). Other characteristics of the two groups are listed in Table 2. In no case were mean differences between the groups statistically significant ($p>.10$).

Table 2

Characteristics of Subjects

	Music Appreciation		Psychology		
	Mean	S. D.	Mean	S. D.	t
Grade Point Average	2.37	.67	2.52	.75	.78
Tonal Memory Scores	50.54	27.49	48.22	30.48	.29
Rhythm Scores	44.80	29.56	45.20	28.72	.05
Years of Musical Experience	3.2	2.3	2.4	2.3	1.44

Dichotic Listening Procedure

The dichotic listening technique described previously was employed in this research (Broadbent, 1954; Kimura, 1964). This procedure involves the simultaneous presentation of two different taped stimuli, one to each ear, through stereo earphones. The subject is then asked to identify each stimulus from among others that are similar. In this manner, independent ear scores are obtained. The assumption underlying the dichotic listening procedure is that, for most individuals, the crossed (contralateral or opposite side) neural pathways between the ears and the cerebral hemisphere are stronger and carry more information than do the corresponding uncrossed (ipsilateral or same side) pathways (Rosenzweig, 1951). Therefore, stimuli presented to the ear opposite the hemisphere specialized for that type of information tend to be processed more efficiently than are stimuli presented to the ipsilateral ear. If, for example, the left-ear (right hemisphere) score is greater than the right-ear (left hemisphere) score, the right hemisphere is considered dominant or primarily responsible for processing that stimulus.

Preparation of tapes. Two tapes were prepared for use in the present study: one of short melodies and one of verbal stimuli. Since verbal stimuli are processed in the left hemisphere (Dimond & Beaumont, 1974), a verbal task was included in this experiment as a basis for comparison with the melodies task.

Melody tape. The series of tones used for the melodies task were produced by a Wurlitzer electronic piano. The researcher chose the electronic piano as the medium for this experiment because of its limited dynamic levels. Maintaining a consistent intensity is an important consideration in constructing dichotic listening examples (for obvious reasons).

The melodies used in the present study were designed after a format devised by Gordon (1970). Eight melodies, composed by a researcher who has conducted extensive research using the dichotic listening technique, encompassed a range of C_4 to an octave above. Each had a different starting and ending pitch and was six to seven notes in duration. The melodic contours varied for each melody. The melodies were composed in $\frac{4}{4}$ time with simple rhythmic division. Each melody occurred as a correct answer the same number of times. The eight melodies are presented in Figure 2.

Figure 2--Melodies Employed in Dichotic Listening Tape

Before recording each melody, an electronic metronome was used to establish a consistent beat and to control for any variation in the length of melodies. The melodies were recorded on a Sony TC-252 D reel-to-reel dual channel tape recorder. The first melody was recorded on both tracks of a magnetic tape. The tape was rewound and the second melody was recorded on just one track. This same procedure was followed for each trial and is illustrated in Figure 3.

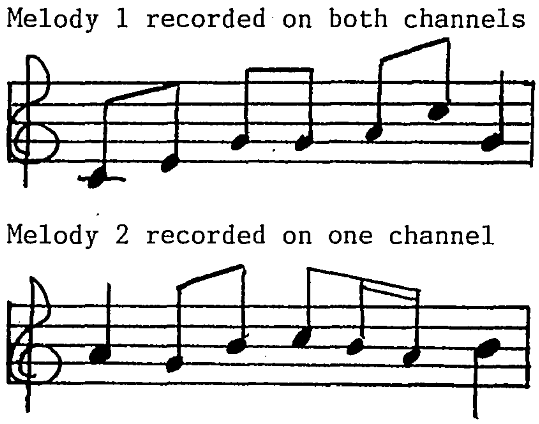


Figure 3--Recording Procedure for Dichotic Melodies

Verbal tape. Stimulus materials for the verbal tape were generated by a computer at Haskins Laboratory in New Haven, Connecticut. Individual consonants (including all consonants in the alphabet) were spoken into a microphone interfaced to a computer and were equalized for length and intensity. A different set of three consonants was recorded on each track of a magnetic tape. The letters were grouped according to length of sound to insure that all examples were of the same duration. For instance, consonants which require a longer time to enunciate, such as "w," were grouped with shorter sounds, such as "t" and "k." The groupings of consonants are listed in Table 3.

Table 3

Consonants Employed in Dichotic Verbal Tape

Trial	Channel 1	Channel 2
1	tls	vwp
2	shm	xbr
3	vmc	gjk
4	jlz	dqm
5	swt	rgz
6	kvx	bpq
7	vdc	hmv
8	qgx	ltw
9	rpm	sbl
10	hpw	jsv
11	dvl	skg
12	brd	mvc
13	cwm	dlp
14	jft	bgm
15	frk	svx
16	mkv	hzx
17	rbm	jst
18	gvq	dlw

Experimental Process

Recordings were presented to each subject by means of a Sony TC-252 D dual channel reel-to-reel tape recorder and Koss K-500 stereo headphones. At the beginning of the experiment, the headphones were balanced by the examiner and set at a comfortable intensity for the listener. This intensity level was determined by a survey of specialists in dichotic research and was maintained for all subjects. The entire experiment lasted for 30 minutes for each subject.

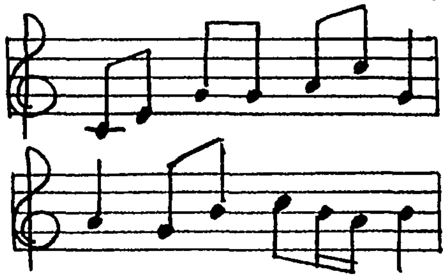
Melodies Task. The melodies task consisted of 24 trials preceded by four practice trials. Each trial was constructed of (1) a statement of the trial number, (2) a dichotic example of two of the short melodic fragments shown in Figure 2, and (3) four melodic fragments presented in sequence binaurally. Each subject was asked to identify the two dichotic melodic fragments from among the four choices and indicate their serial position in the sequence by marking two corresponding spaces on an answer sheet. The text of the tape follows:

Dichotic Melodies Recorded Text

> This is an experiment in musical memory. It is not intended to be a test of musical ability, so don't be discouraged if you find the musical tasks to be difficult. No one is expected to make a perfect score. The primary purpose of this experiment is to find out how people remember music under certain conditions. It is important, however, that you follow instructions carefully and try to do the best you can.
>
> First, look at the instructions in front of you. For each question in this experiment you will hear two short melodies played simultaneously, one to each ear as displayed in the diagram, sounding something like this:

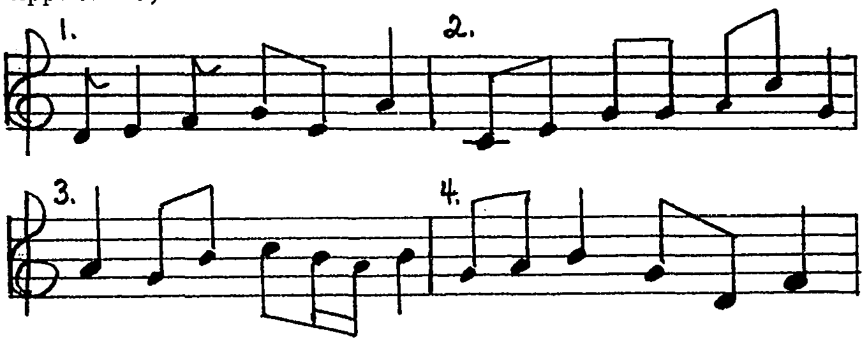
Right ear

Left ear



> Following these two melodies played simultaneously, you will hear four short melodies played one after the other to both ears, sounding like this: (All melodies are heard on the tape and are not displayed on the

answer sheet. For an example of an answer sheet, see Appendix.)



Two of the melodies--one, two, three, or four--that you just heard were identical to the two melodies you heard played simultaneously. Look at the sample of the answer.

Trial 1. _____ _____ _____ _____

Your job during the experiment is to check the spaces (one, two, three, or four) which correspond to the positions in the sequence of the two melodies you heard played simultaneously earlier. In this instance, as you can see in the answer sheet example, the correct answers were spaces two and three.

Verbal Task. The procedure for the verbal task was similar to that of the melodies task, except that subjects heard sets of spoken consonant sounds. In this task there were 24 trials, six of which were practice trials. The text of the tape follows:

Dichotic Verbal Tape Text

This is a multiple choice memory task. You will be presented two sets of three letters. One set of three letters will be presented to one ear and at the same time another set of three letters will be presented to the other ear. These letters will sound similar to this.

Right Ear	Left Ear
zmc	gjk

> Your task is to remember the sets of letters presented to each ear. You will then hear four possible answers. That is, four sets of three letters will be presented in sequence. Your task is to pick out the two original sets of letters from among the four choices. You are to indicate your two choices of correct answers by placing check marks on the appropriate places on the answer sheet. For example, on Trial Number One, if the first and third sets of letters are the correct responses, place a check mark in blank one and three of Trial One.
>
> Now this is a difficult task and we do not expect you to get all of the answers correct. Do the best that you can and if you are not sure you may guess, but be sure to check two spaces for each trial. There will be six practice trials after which we will pause to see if you have any questions. The practice trials now begin.

The tests were administered individually outside of class. Each test was presented to each subject as a pretest at the beginning of the semester and as a posttest at the completion of the semester. The order of the tasks was counterbalanced to control for possible order effects.

Method of Instruction for Experimental and Control Groups

The students who served as experimental subjects in this research were enrolled in a music appreciation course (for fifteen weeks of instruction) in which the instructor was an associate professor of music who had taught music appreciation for 13 years. The text used was Joseph Kerman's Listen. The method of instruction was entirely by lecture, using recorded materials as examples. The instructor discussed form and analysis of melodic material primarily during the study of the classical periods of music composition. The students who served as control subjects in this research were enrolled in an introduction to psychology course for fifteen weeks of instruction.

The instructor was an associate professor of psychology who had taught psychology for 12 years. The method of instruction was primarily by lecture.

Data Analysis

Frequency tabulations of correct scores for each ear were obtained for each subject in the experimental and control groups. Double-correct scores which were correctly identified by both left and right ears simultaneously were also tabulated. The mean scores for each group were used to determine which ear was dominant in processing examples of the melodies and verbal tasks. The significance of difference scores between the pretest and posttest was compared by conducting students' *t* tests for dependent samples. An analysis of covariance was performed to adjust posttest scores based on possible variation in pretest scores.

Correlations were calculated to identify possible relationships between scores on the MMT and scores obtained from both dichotic listening tasks. Other correlations were investigated to determine whether relationships existed between dichotic listening scores, MMT scores, and previous musical experience. Measures were correlated separately for subjects in each group. The reliability of the melodies and verbal tasks was examined by computing reliability measures using Kuder-Richardson formula 20.

Subsequent to the above procedures, the results were compared to the results of other studies of information processing to investigate a shift in laterality following a one-semester music appreciation course.

CHAPTER IV

RESULTS

Subjects were 54 students from a music appreciation (MA) and a psychology (PSY) class who listened to melodic and verbal dichotic listening tapes at the beginning and end of a semester of study. They responded to 24 trials on a melodies task and 18 trials on a verbal task by marking their answers on a separate answer sheet for each task.

Scoring

Scores for each subject in the experimental (MA) and control (PSY) groups were obtained by determining the number of correct identifications for each ear for each task. Double-correct scores were obtained by counting the number of trials in which subjects correctly identified both the stimuli given the left and right ears. There were two steps in tabulating scores. Right- or left-ear scores were identified for each subject, then double-correct scores were recorded. Since double-correct scores were those that subjects identified correctly using both ears, a second step in tabulating scores was performed to reflect the addition of double-correct scores to individual ear scores. For example, a subject who identified 7 left-ear scores, 4 right-ear scores, and 5 double-correct scores would be credited with scoring 12 left-ear, 9 right-ear, and 5 double-correct scores.

To determine which ear was dominant in identifying each task, left-ear scores were subtracted from right-ear scores, resulting in right-ear advantage scores. Negative scores in this category would identify a left-ear advantage. Mean scores for experimental and control groups were calculated and are presented in Tables 4 and 5.

Table 4

Mean Scores for Music Appreciation Sample

	Mean	S. D.
Melodies Task		
Pretest		
Right-ear scores	12.519	3.837
Left-ear scores	14.074	3.496
Posttest		
Right-ear scores	13.704	2.959
Left-ear scores	14.778	2.873
Right-ear advantage scores		
Pretest	-1.556	6.204
Posttest	-1.074	4.150
Posttest-Pretest	0.481	7.802
Double-correct scores		
Pretest	5.000	3.408
Posttest	6.889	3.662
Verbal Task		
Pretest		
Right-ear scores	14.222	8.819
Left-ear scores	13.630	2.619
Posttest		
Right-ear scores	14.815	2.288
Left-ear scores	15.259	2.411
Right-ear advantage scores		
Pretest	0.593	2.872
Posttest	-0.444	2.100
Posttest-Pretest	-1.037	3.391
Double-correct scores		
Pretest	10.519	3.512
Posttest	12.630	3.078

Table 5

Mean Scores for Psychology Sample

	Melodies Task	
	Mean	S. D.
Pretest		
Right-ear scores	13.145	3.313
Left-ear scores	14.296	2.046
Posttest		
Right-ear scores	14.778	4.228
Left-ear scores	14.889	3.274
Right-ear advantage scores		
Pretest	-1.148	4.614
Posttest	-.111	4.799
Posttest-Pretest	1.037	4.957
Double-correct scores		
Pretest	5.556	3.994
Posttest	7.778	5.041
	Verbal Task	
Pretest		
Right-ear scores	14.741	2.551
Left-ear scores	14.222	3.262
Posttest		
Right-ear scores	15.192	2.623
Left-ear scores	14.423	2.671
Right-ear advantage scores		
Pretest	.385	3.167
Posttest	.769	2.197
Posttest-Pretest	.385	4.129
Double-correct scores		
Pretest	11.333	4.412
Posttest	12.154	3.484

Melodies Task

Both experimental and control groups showed left-ear superiority for the melodies task. There was no significant difference between the pretest and posttest for the MA (t_{26} =.32, p=.75) or PSY groups

($\underline{t}_{26}$=1.09, p=.29). This finding supports the null hypothesis that there is no significant difference between the mean ear difference scores on the pretests and posttests, as measured by a dichotic listening task of melodic stimuli, between students enrolled in a music appreciation class and students in a psychology class.

The fact that both groups showed a left-ear advantage for processing melodies is consistent with the literature cited above (Kimura, 1964, 1973; McCarthy, 1969; Milner, 1962) describing music as a right-hemisphere, holistic process. Some researchers (Bever & Chiarello, 1974) have found that the musical experience of a perceiver may influence the cerebral processing of melodic stimuli. Bever and Chiarello found that musicians, because of training, assume a more sequential, analytical approach to the processing of melodies. They employ the left hemisphere for processing melodic stimuli to a greater extent than do nonmusicians, who tend to rely upon a holistic strategy for processing melodies. The results of the present study are consistent with Bever and Chiarello's finding concerning nonmusicians.

Although both experimental and control groups showed left-ear dominance for the melodies task, mean left-ear scores decreased on the posttest. This change in scores was not of sufficient magnitude to reflect a shift in dominance, thereby supporting the null hypothesis that there is no significant shift in ear dominance for melodic stimuli, as measured by a dichotic listening task, for students enrolled in a one-semester music appreciation course. According to the results, the treatment did not produce a shift in laterality among students in the experimental group.

An analysis of covariance was performed to adjust posttest scores for possible residual differences betwen mean pretest scores. According to the results, the treatment produced no significant difference ($F_{1,53}$=.62, p=.43) in adjusted mean posttest scores obtained from the MA and PSY groups on the melodies task of a dichotic listening test, administered at the end of a semester.

Verbal Task

Researchers (Dimond & Beaumont, 1974) have found that processing of verbal stimuli is considered primarily a left-hemisphere function. In the PSY group, the mean scores for the verbal task showed a consistent right-ear advantage between pre- and posttest scores. In the MA group the right-ear advantage score on the pretest was .593 and was -.444 on the posttest. The negative number on the posttest indicated a change, although slight in this case, in processing to the right hemisphere. Possible reasons for this shift are presented in Chapter V.

An analysis of covariance was performed comparing mean pre- and posttest scores for the verbal task. Differences between the two groups of scores were found to be statistically significant ($F_{1,51}$=4.15, p<.05).

Double-Correct Scores

Double-correct scores, indicating trials in which both left- and right-ear stimuli were correctly identified, were presented in Tables 4 and 5. According to Berlin (1977), double-correct scores reflect an increase in brain processing efficiency. Although both groups showed an increase in frequency of double-correct scores on the posttest, neither increase was statistically significant ($p > .05$). These results support the null hypothesis that there is no significant increase in double- correct scores, as measured by a dichotic listening task, for students enrolled in a one-semester music appreciation course.

Pearson product-moment correlation coefficients comparing double-correct scores for melodies and verbal tasks indicated a consistent pattern of double-correct scores for both groups. A moderate relationship existed between double-correct scores on pre- and posttest and between the melodies and verbal tasks. See Table 6 for these data.

Table 6

Pearson Product-Moment Correlation Coefficients Comparing Double-Correct Scores (N=54) for Melodies and Verbal Tasks

	Pre-Melodies	Pre-Verbal	Post-Melodies	Post-Verbal
Pre-Melodies		.38	.78***	.52**
Pre-Verbal			.45**	.54**
Post-Melodies				.58**

* ($p < .05$)
** ($p < .01$)
*** ($p < .001$)

To further investigate the finding that music is primarily a function of the right hemisphere, Pearson product-moment correlation coefficients were computed comparing double-correct scores on the melodies task and left-ear scores for the combined groups (see Table 7). Since left- and right-ear scores are included in computing double-correct scores, correlations between melodies scores in this table are spuriously inflated.

Table 7

Pearson Product-Moment Correlation Coefficients between Double-Correct Melodies Scores and Left-Ear Scores

		Left-Ear Scores
Pretest Double Correct Melodies Scores	.33 **	Pretest Verbal
	.33 **	Posttest Verbal
	.42 **	Pretest Melodies
	.48 ***	Posttest Melodies
Posttest Double Correct Melodies Scores	.26 *	Pretest Verbal
	.30 *	Posttest Verbal
	.34 **	Pretest Melodies
	.73 ***	Posttest Melodies

* $(p<.05)$
** $(p<.01)$
*** $(p<.001)$

Seashore Measures of Musical Talents

Tonal memory and rhythm scores from the Seashore Measures of Musical Talents (MMT) were used in this experiment as a means of matching the two groups of subjects for musical aptitude. To investigate the relationship between a measure of musical aptitude and right-hemisphere dominance for processing musical stimuli, Pearson product-moment correlation coefficients were computed comparing left-ear scores and tonal memory scores on the MMT. This relationship was significant for melodies and verbal tasks, except for the verbal task on the posttest. This provided additional support for music processing as a right-hemisphere function (see Table 8).

Table 8

Pearson Product-Moment Correlation Coefficients between Tonal Memory Scores from the Seashore MMT and Left- and Right-Ear Scores

	Left-Ear Scores	Right-Ear Scores	
Tonal Memory Scores	.30 *	-.01	Pretest
Melodies			
	.28 *	-.07	Pretest Verbal
	.44 *	.16	Posttest
Melodies			
	.18	.29*	Posttest Verbal

* ($p<.05$)

As indicators of musical aptitude there was a moderate relationship ($r=.46$, $p<.001$) between rhythm and tonal memory scores on the MMT for the combined group of subjects. Neither rhythm ($r=.19$) nor tonal memory ($r=.14$) scores were strongly correlated with musical experience for subjects in this study.

Even though the MA and PSY groups were matched according to scores on the MMT, differences between the two groups, which will be discussed later, might offer explanations for the lack of effect in this experiment. Even though there was a moderate correlation between rhythm and tonal memory scores ($r=.46$), groups differed somewhat on this correlation. In the PSY group, moderate correlations existed between rhythm scores and verbal scores, suggesting that this group might have a left-hemisphere dominance for processing linear information. See Table 9 for these correlations.

Table 9

Pearson Product-Moment Correlation Coefficients between Seashore MMT Rhythm Scores and Verbal Scores for the PSY Group

Rhythm	.44 *	Pretest Double Correct
	.45 *	Posttest Double Correct
	.42 *	Pretest Left Ear
	.33	Pretest Right Ear
	.43 *	Posttest Left Ear
	.39 *	Posttest Right Ear

* $(p<.05)$

A moderate negative correlation $(r=-.47, p<.001)$ between rhythm scores in the PSY group and difference scores for the melodies task between the pretest and posttest was also found. This same relationship for the MA group was $r=.09$.

Reliability of Measures

Reliability coefficients for the melodies and verbal tasks were computed using Kuder-Richardson formula 21 reliability estimates. Reliability coefficients for left-, right-, and double-correct ear scores for each task are reported in Table 10.

Table 10

Reliability Coefficients for Left-, Right-, and Double-Correct Ear Scores on Melodies and Verbal Tasks

Melodies Task Right Ear	r=.63
Melodies Task Left Ear	r=.56
Melodies Task Double Correct	r=.69
Verbal Task Right Ear	r=.75
Verbal Task Left Ear	r=.65
Verbal Task Double Correct	r=.77

CHAPTER V

CONCLUSIONS

The purpose of this study was to investigate the possible effects of a one-semester music appreciation course on changes in hemispheric processing of musical stimuli by college students. Subjects from a music appreciation class (experimental group) and a psychology class (control group) listened to melodic and verbal dichotic listening tapes at the beginning and end of a semester of study. Results were analyzed to determine whether there was a significant difference between the pre- and posttest scores of both groups. The research questions were as follows:

1. Do students who have completed a one-semester music appreciation course process musical stimuli, as measured by a dichotic listening task, differently than do students who have never formally studied music appreciation?

2. Are college students who have completed a one-semester music appreciation course more efficient in processing musical stimuli as measured by a dichotic listening task, than students who have never formally studied music appreciation?

3. Does a one-semester college music appreciation course alter the hemisphere in which students process musical stimuli?

Discussion

Melodies Task

The findings of the present study indicate that a one-semester music appreciation course does not have an effect on how students listen to melodic stimuli, as measured by a dichotic listening task. There was no significant difference between pre- and posttest scores on the dichotic melodies task for students enrolled in a college music appreciation course and students enrolled in an introductory psychology course. Both groups showed right-hemisphere dominance for processing melodies.

Since music embodies a variety of aural constructs, the research literature presents contradictory conclusions as to which hemisphere is primarily responsible for processing musical stimuli. The majority of researchers (Kimura, 1964; McCarthy, 1969; Milner, 1962) have identified the right hemisphere as specialized for the processing of musical and nonverbal input, with the left hemisphere being dominant for verbal functions. The results of the present study are consistent with their findings for musical stimuli.

A subject's musical training might have some influence on which hemisphere is dominant for processing musical stimuli. Bever and Chiarello (1974) suggested that trained musicians employ the left hemisphere in processing melodies with greater consistency than do nonmusicians, who show more right-hemisphere involvement with this task. According to the results of the present study, a one-semester music appreciation course did not significantly alter the hemisphere in which students processed musical stimuli.

In this experiment, musical experience was defined as years of private instruction on a musical instrument as well as participation in performance groups in high school or college. The students participating in this experiment had a history of different musical experiences. In the Bever and Chiarello study, nonmusicians were classified as having less than three years of private instruction at least five years before the experiment. Even though the mean years of study for both groups was less than three years, 45 percent of the students in the present study had studied music for three or more years and would not have met the criteria for nonmusician in the Bever and Chiarello study.

In the present study, the Seashore Measures of Musical Talents were administered to all participants as a means of matching the experimental and control groups for musical aptitude. In order to obtain similar groups according to musical aptitude, scores from the Seashore test were used as a criterion for subject selection. This represents a departure from the Bever and Chiarello study, where the number of years of musical experience was used as a criterion for subject selection. This difference in procedure could explain a lack of effect in the present study. The subjects participating in this study could not be considered professionally trained musicians nor would they fit the qualifications for "nonmusicians" as defined by other researchers (Bever & Chiarello, 1974; Hirshkowitz, Earle & Paley, 1978; Schweiger,1981; Wagner & Hannon, 1981).

Although there was no significant relationship between years of musical experience and ear dominance, a moderate negative relationship (r=-.39) was found between the difference scores (posttest minus pretest) for the melodies task and musical experience. Scores on the melodies task indicated a right-hemisphere dominance for both groups. Although this finding reflects a moderate relationship, it is interesting that as years of musical experience increased, subjects' scores on the melodies task gravitated toward left-hemisphere dominance. This is in agreement with the findings of other researchers cited above, who reported that as musical experience increased, subjects employed a left-hemisphere strategy for processing musical stimuli. There was no significant difference between the experimental and control groups in this relationship between musical experience and ear dominance. Any shift in hemispheric dominance could not be attributed to the treatment in this study.

Seashore (1960) stated that musical experience and musical aptitude are not related. In the present study, neither rhythm (r=.19) nor tonal memory (r=.14) scores on the Seashore MMT was strongly correlated with musical experience. This lack of significant relationship is consistent with Seashore's theory. For this reason, the present researcher would recommend "musical experience" rather than "musical aptitude" as a criterion for subject selection in further research in this field.

Double-correct scores. Berlin (1977) has suggested that double-correct scores on dichotic listening tasks reflect the ability to process signals that overlap temporally and provide an index of brain efficiency. In this study, both experimental and control groups showed an increase in double-correct scores on the posttest, but the difference between the two groups was not great enough to be statistically significant. In the Music Appreciation (MA) group there was an 8 percent increase in double-correct scores on the melodies task and 12 percent, on the verbal task. The Psychology (PSY) group showed a 9 percent increase on the melodies task and 5 percent on the verbal task. The increase in double-correct scores could not be attributed to the treatment, since both groups showed an increase on the posttest. A possible reason for the increase could be that subjects' performance on the dichotic listening test improved on the second administration, as the dichotic tasks became easier and more familiar for them.

Moderate to strong linear relationships (r=.26 and .73) were found to exist between double-correct scores on the melodies task and left-ear scores on both tasks, verbal and melodies, respectively. This suggested that, as students became more proficient at identifying both melodies in the dichotic trials, right-hemisphere strategies for identifying both tasks were also developing. This finding further supports the theory that processing music is a function of the right hemisphere with individuals used in this study.

Verbal Task. According to research (Levy-Agresti & Sperry, 1968), verbal stimuli are processed in the left hemisphere which has been shown to be responsible for serial or analytical processing. The subjects in this study indicated a left-hemisphere dominance for verbal processing on almost all tasks. However the MA group showed a shift to the right hemisphere on the posttest. There was a slight difference (.44) between mean right- (14.82) and left- (15.26) ear scores, indicating a right-hemisphere dominance.

Regardless of precautions to match the experimental and control groups and careful preparation of the melodic and verbal dichotic listening tapes, the subjects in the MA group scored differently from subjects in other studies using verbal dichotic listening tests. One reason for this could be a ceiling effect on the verbal task, as evidenced by the number of double-correct scores. Apparently the verbal task was simple. Out of a possible 18 items on the test, the MA group averaged 58 percent double corrects on the pretest and 70 percent on the posttest. The PSY group averaged 62 percent on the pretest and 68 percent on the posttest. This ceiling effect allowed for little variation between right- and left-ear scores. For this reason it was difficult to accurately evaluate the results of the verbal task.

Reliability of measures. The dichotic listening procedure has prompted extensive research assessing its validity and reliability (Blumstein, Goodglass & Tarttler, 1975; Fennell, Bowers & Satz, 1977; Pizzamiglio, Pascalis & Vignati, 1974). These studies support the reliability of dichotic listening procedures as applied to right-handed subjects. In these studies test-retest measures were conducted to obtain reliability coefficients. In the present study, reliability coefficients were determined by Kuder-Richardson formula 21 reliability estimates and, although moderate, are consistent with the findings of other studies.

Processing strategies of control and experimental groups. Even though the two groups were matched according to musical aptitude scores, some differences between the two groups identified by post hoc analyses could offer explanations for the lack of effect. In the PSY groups moderate relationships were found between scores on the rhythm task on the MMT and verbal scores. These same relationships for the MA group were not significant.

In the literature reviewed previously, discrepancies existed concerning the identification of a dominant hemisphere when processing rhythm. In this experiment, as in other hemisphere research in music, there was no attempt to control for rhythm and melody as separate variables. Baumgarte and Franklin (1981) tested subjects using tonal patterns and rhythm patterns as two separate tasks, and found that nonmusicians processed rhythm in the left hemisphere. The relationships found between rhythm scores and verbal scores for the PSY students suggest that they might have been more left-hemisphere oriented in processing information than were the MA subjects.

A moderate negative correlation ($r=-.47$) was found for the PSY group relating rhythm scores to difference scores (posttest minus pretest) on the melodies task. This same correlation for the MA group was very small ($r=.09$). Again this indicated differences in processing strategies between the two groups, which could account for the lack of effect.

In Gordon's research (1970, 1975, 1980) when testing musicians and nonmusicians, no difference between the two groups in right-hemisphere processing strategies for music was evident. He concluded that there are some individuals, regardless of training, who are more capable of using the left hemisphere. The present research supports Gordon's theory. Even though mean ear scores reflected some right-hemisphere dominance for processing music, there was a lack of homogeneity for both groups. It was difficult to identify patterns for processing music and verbal stimuli among subjects. There appeared to be more individuals who listened analytically to the dichotic tasks in the PSY group than in the MA group. Reasons for this are unexplainable in the present research.

In addition to possible differences between groups in processing strategies, task requirements in this experiment might offer an explanation for a lack of effect. Peretz and Morais (1980) interviewed subjects after listening to dichotically presented musical stimuli and found that an analytic approach for listening to melodies was not exclusive to musicians. When subjects found a cue for distinguishing the stimuli, they were able to approach the task in an analytical manner; thus, a procedure similar to the Peretz and Morais experiment is recommended for future studies in this area. A comparison of test results with information obtained in interviews following administration of the listening task might give more insight into subjects' processing strategies.

Recommendations

Mueller (1956) suggested that in order to achieve more effective teaching, music educators must devise experimental methods for "prying into the mental processes involved in 'hearing' and understanding music. The typical resistances, difficulties, short-cuts, and insights must be understood and anticipated (p. 3)." Examining hemisphere research and its relation to how music is processed is one way of attaining this goal. As educators learn more about processing strategies, methods of teaching can be structured to expand analytic and holistic approaches to problem solving.

Perhaps musicians approach listening to music with different strategies than do individuals who have had less training in music. Researchers testing hemispheric dominance for music processing continue to reveal different results concerning the effects of musical training. A possible reason for these discrepancies is that listening to the different elements of music requires a variety of processing strategies. Some researchers (Baumgarte & Franklin, 1981) have found that musicians approach the task of listening to melodies in an analytic mode; however, when rhythm is isolated from melodic material, musicians employ a holistic approach to processing.

A problem with this type of research involves the possibility that elements which embody music probably are perceived as a whole. To dissect music into its separate elements might be appropriate for the laboratory but for the music appreciation classroom, this becomes an exercise in futility.

More research needs to be conducted in the area of hemispheric dominance using a variety of methods. Clinical studies and experimental research have been effective in providing information about hemispheric dominance. Perhaps other methods of revealing processing strategies for music would provide additional information in this area.

From the results of this study, it is recommended that research procedures include testing methodology utilizing preliminary instructions as aids to listening. It would perhaps be more conclusive if subjects were tested at the beginning and end of a semester of music appreciation wherein instructional cues are used in addition to the dichotic listening procedures. The present research shows that music appreciation students do not process melodic material in an analytic manner. If more specific instructions were provided with a focus on how to listen, would a music appreciation course help students to listen more analytically?

Another unanswered question introduced by the present research was whether the method of instruction affects music processing for music appreciation students. The students who served as subjects in this research were enrolled in a music appreciation course whereby the method of instruction was entirely lecture-based, supplemented only with recorded music examples. Would a different method of instruction, in which students were allowed more participation, both in performance and class discussions, have altered the results of the present research?

Research cited in this study focuses on the fact that many strategies are involved in processing music. For this reason, the present researcher would recommend a variety of methods for teaching music appreciation, including presentation of short pieces familiar to students as illustrations, as well as encouraging student participation.

Although several unanswered questions remain concerning the effects of a one-semester music appreciation course on hemisphere laterality, it is apparent that instructors need to stimulate both analytic and holistic approaches toward listening to music when devising methods of instruction. Researchers in hemisphere laterality have revealed that individuals process music differently. For this reason, it is important that teachers identify these processes and structure methods of instruction accordingly.

In the present research, college students have not proved to be homogeneous in the processing strategies they use for music. There is a need for innovative teaching techniques to challenge this population of students. Students who leave their college music appreciation course with positive musical experiences and more acute listening skills might be encouraged to become more active life-long participants as consumers of music.

In summary, from the results of the present research the following recommendations are made.

1. There is a need for further research in hemisphere laterality and its relationship to music processing using a variety of experimental methods.

2. There is a need for further research in the area of testing whether method of instruction in a music appreciation classroom might have any effect upon students' processing strategies for music.

3. Teachers of music appreciation classes need to utilize many methods of instruction, since the processing of music involves a variety of strategies.

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APPENDIX

QUESTIONNAIRE

Please complete all items on this questionnaire to the best of your ability.

Name ________________________ Age ______ Phone number ___________

Campus Address ______________ Sex ______ G.P.R. _________________

Race ________________________

I. Musical background

1. Have you studied Music Appreciation previously here or elsewhere?_______
   If yes, specify when and where ____________________________

2. List the performing groups you played or sang with in high school (or college).
   a.

   b.

3. Have you ever received private instruction on a musical instrument? ________ If yes, when and for how long? ________
   ____

II. Handedness. Please indicate your preferences in the use of hands for the following activities by placing + in the appropriate column. Where the preference is so strong that you would never try to use the other hand unless absolutely forced to, put ++. If in any case you are really indifferent, put - in both columns. Please try to answer all the questions.

	TASK	Left	Right
1.	Writing	_____	_____
2.	Drawing	_____	_____
3.	Throwing	_____	_____
4.	Scissors	_____	_____

5. Toothbrush _____ _____

6. Knife (without fork) _____ _____

7. Spoon _____ _____

8. Broom (upper hand) _____ _____

9. Striking match (which hand holds the box) _____ _____

10. Opening box (which hand removes the lid?) _____ _____

11. Which foot do you prefer to kick with? _____ _____

12. Which eye do you use when using only one? _____ _____

III. Hearing

1. Do you have any history of hearing difficulties or ear injuries? ______________________________

   If so, please describe. ______________________________

2. When did you last have a hearing test? ____________________

   Was your hearing normal at the time? ____________________

IV. Please use the back of this sheet for a copy of your present class schedule. Indicate any work hours, or weekly meetings that you have on a regular basis.

V. Participation in this study will require two hours of your time; one hour at the first of the semester and one hour at the end of the semester. Are you willing to participate? ________________

Answer Sheet for Melodies Task

Name ________________________

Ex. _____ _____ _____ _____

Practice Trial 1. _____ _____ _____ _____

Practice Trial 1. _____ _____ _____ _____

Practice Trial 3. _____ _____ _____ _____

Practice Trial 4. _____ _____ _____ _____

1. _____ _____ _____ _____
2. _____ _____ _____ _____
3. _____ _____ _____ _____
4. _____ _____ _____ _____
5. _____ _____ _____ _____
6. _____ _____ _____ _____
7. _____ _____ _____ _____
8. _____ _____ _____ _____
9. _____ _____ _____ _____
10. _____ _____ _____ _____
11. _____ _____ _____ _____
12. _____ _____ _____ _____
13. _____ _____ _____ _____
14. _____ _____ _____ _____
15. _____ _____ _____ _____
16. _____ _____ _____ _____
17. _____ _____ _____ _____
18. _____ _____ _____ _____
19. _____ _____ _____ _____
20. _____ _____ _____ _____
21. _____ _____ _____ _____
22. _____ _____ _____ _____
23. _____ _____ _____ _____
24. _____ _____ _____ _____

Answer Sheet for Verbal Task

Name ____________________________

Practice Trial 1. _____ _____ _____ _____

Practice Trial 2. _____ _____ _____ _____

Practice Trial 3. _____ _____ _____ _____

Practice Trial 4. _____ _____ _____ _____

Practice Trial 5. _____ _____ _____ _____

Practice Trial 6. _____ _____ _____ _____

1. _____ _____ _____ _____

2. _____ _____ _____ _____

3. _____ _____ _____ _____

4. _____ _____ _____ _____

5. _____ _____ _____ _____

6. _____ _____ _____ _____

7. _____ _____ _____ _____

8. _____ _____ _____ _____

9. _____ _____ _____ _____

10. _____ _____ _____ _____

11. _____ _____ _____ _____

12. _____ _____ _____ _____

13. _____ _____ _____ _____

14. _____ _____ _____ _____

15. _____ _____ _____ _____

16. _____ _____ _____ _____

17. _____ _____ _____ _____

18. _____ _____ _____ _____