A TEST OF EAR PREFERENCE FOR MUSIC

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A DISSERTATION SUBMITTED IN PART FULFILLMENT FOR THE

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To

My Father and Mother

CERTIFICATE

This is to certify that the Dissertation entitled “A Test of Ear Preference for Music” is the bonafide work in part fulfillment for the degree of M.Sc. Speech and Hearing, carrying 100 marks, of the student with Register No. 62

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CERTIFICATE

This is to certify that this Dissertation has been prepared under my Supervision and Guidance.

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GUIDE

DECLARATION

The dissertation entitled “A Test of Ear Preference for Musci” is the result of my own study undertaken under the guidance of Mr. M.N. Vyasamurthy, Lecturer in Audiology, All India Institute of Speech and Hearing, Mysore. This has not been submitted earlier at any other University for any other Diploma or Degree.

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CHAPTER I

INTRODUCTION

The neural substrate for musical ability has been the subject of much inconclusive discussion. The traditional view based on clinical studies of “amusia” is that the left hemisphere, particularly the left temporal lobe, is the area most concerned with music functions (Henschen and Schaller, 1925; Ustvedt, 1937. Most of these studies suffer from the two fold disadvantage of an incomplete knowledge of the lesion, and an inadequate testing of musical function nearly always contaminated by verbal factors in instruction, naming, etc. A recent study free of these drawbacks found instead that efficient performance on certain non-verbal auditory task rests more with the right temporal lobe than with the left. Milner (1962) reported that score on the Timbre and Tonal Memory subtests of the Seashore Measures of Musical talents were depressed by right temporal lobectomy but not by left temporal lobectomy.

It has previously been shown, in normal subjects, that the predominant role of the left hemisphere in the perception of speech sounds is reflected in better recognition of verbal material arriving at the contralateral ear (Kimura, 1961a). When different spoken digits were presented simultaneously to the two ears, those digits arriving at the right ear were more efficiently recognized than digits arriving at the left. This situation is possible because the crossed auditory pathways are more effective than the uncrossed (Kimura, 1961b). One might therefore expect that the predominance of one hemisphere for the perception of musical sounds should reveal itself in an asymmetry analogous to that for speech sounds. Specifically, if the right temporal lobe is more involved in musical recognition than the left, it should be possible to demonstrate a left ear superiority for musical sounds, in the same subjects in whom the right ear is more efficient for verbal material.

The fact that melodies presented to the left ear are more accurately recognized than those arriving at the right supports Milner’s (1962) view that the right temporal lobe plays a greater role in non-verbal auditory perception than does the left. Due to the grater effectiveness of the crossed pathways, melodies arriving at the left ear are more efficiently transmitted to the right temporal lobe, an area most important for their perception, than are melodies arriving at the right ear. An analogous but opposite effect occurs for verbal material presented to the two ears. Thus the left right differences which occur reflect an asymmetry of function in the two cerebral hemispheres.

The asymmetry is not due to a difference in the sensitivity of the two temporal lobes to the frequency characteristics of sound for the puretone loss after temporal lobectomy is very slight and the pattern of loss is the same after right temporal lobectomy as it is after left temporal lobectomy (Sinha, 1959). The differentiation appears to be along the verbal-non verbal dimension, and among non-verbal sounds music may be especially effective in eliciting a left ear effect. This was suggested by a preliminary study employing the presentation of different number of clicks to the two ears simultaneously. The results again showed a trend for the left ear to have a higher score, but unlike the results for melodies the effect was not significant. The right hemisphere may thus be especially important for the perception of melodic patterns (Kimura, 1964).

The symmetries observed here occur only when under conditions of dichotic stimulation. In an unpublished study (Quoted from Kimura, 1964), the Timbre test of the Seashore battery was presented to a group of normal subjects, one ear at a time, on two separate occasions. This procedure yielded no difference between ears. Similarly, the right ear effect for digits occurred to a significant extend only with dichotic presentation. One reason for this may be that dichotic listening puts more demands on the system than does monaural listening. However, there is probably another factor involved. Rosenzweig (1951) has suggested that the auditory system is so arranged that some central units in each half of the brain fire to stimulation of the ipsilateral ear, some to the contralateral ear, and some to both. More units are activated by contralateral stimulation than by ipsilateral, but in addition in those units which fire to both, the contralateral connections occlude the ipsilateral. Thus, the grater effectiveness of the contralateral pathways should become more apparent when both ears are stimulated, but with different material. In terms of the right temporal lobe in the recognition of melodies, when different melodies are presented to the two ears there are two possible pathways to the right temporal lobe: the ipsilateral pathways (from the right ear) and the contralateral pathway (from the left ear) ignoring the slower connections (pathways to the left temporal lobe and subsequent commissural connections to the right). When only one ear is stimulated at a time, the difference between easy may not be great enough to permit detection of a difference. When different information travels along these pathways, however, those units which fire to both ears will be taken up by the contralateral (in this case left ear) pathway, according to Rosenzwig’s system. In this way dichotic stimulation may enhance the difference between the two pathways.

An assumption basic to this argument is that the main difference between ipsilateral and contralateral pathways is the number of units they command. Results obtained form animal studies by both Tunturi (1946) and Rosenzweig (1951) suggest that this is so. They found that if a click was presented to the ear, and records taken from ipsilateral and contrateral auditory cortex, the only difference between the responses at these two sides was in amplitude. There was no detectable difference in either latency or duration. Thus, it does appear that it is not the earlier arrival of impulses from the contralateral pathways which results in the asymmetries seen, but rather, the greater number of impulses.

Recently, Robinson and Solomon (1974) challenging the left ear-right hemisphere combination for the perception of melodic patterns have conducted an experiment in which conflicting resulting had been obtained. Their study showed that the non speech rhythmic patterns carrying no phonetic information were processed by the same hemisphere as speech. These results suggest that since rhythmic patterns are the only non speech auditory stimuli to share the processing of the left hemisphere with speech, models involving rhythmic organization in speech cognition are to be encouraged. Since both speech and rhythm require hierarchical organization, it is likely that the left hemisphere is better able to process hierarchically.

In the light of the above evidence, the present study has been conducted to determine as to which ear is more efficient in appreciating musical tunes. Since rhythm is an integral part of music, an attempt is made to throw more light on the perceptual processes of rhythmical tunes.

The study concerns itself with the following four null hypotheses:

1) In normals, there is no significant difference in the performance of two ears for the perception of music.

2) Males and females do not differ significantly in their performance on this test of ear preference.

3) In stutterers, there is not significant ear preference for the perception of music and

4) Trained musicians do not differ significantly from normals with reference to ear preference for music.

Music was used as stimulus because of its common appeal. Developing a test for ear preference using verbal stimuli was difficult because due to the practical problems of multiple languages in our country. As, a common test for ear preference was in great demand, music was the outright choice.

Brief Plan of the Study

A test was developed with 13 events out of which 10 were test events and 3 were control events. In each test event, one ear gets a constant piece of tune and the other ear receives the distorted version of the constant tune and two other distorted tunes, one at a time in a dichotic fashion. After listening to the whole event, the subjects is asked to find one of the three distorted tunes which closely resembles the constant piece of tune in the other ear. The purpose of the control event is to check the responses of the subject. In such an event, the distorted version of the constant tune, is not present and it is replaced by another distorted tune. The subject is expected to indicate that there is no exact resemblance between the constant and the distorted tunes.

First the subject has to listen to 13 events and then the earphones are reversed the whole tape is played back. The total number of correct identifications from 10 test events is converted into percentage scores of the ear, receiving the distorted pieces of tunes. In other words, always the ear receiving constant piece of tune is taken as the reference ear and the other ear receiving distorted pieces of tunes is taken as the test ear.

The stimuli were recorded on a Jai tape using Uher (Variocord 263) stereo tape recorded the presented through a calibrated Madsen (OB 70) clinical audiometer having TDH 39 earphone fitted with circumaural cushions.

Three groups of subjects have been studied in the present study – 50 Normals (25 Males and 25 Females), 10 stutterers and 10 trained musicians. Their ear preference for music has been examined.

Implications

Laterlity effects during dichotic listening have important implications not only for the evualtion of central auditory disorders but to the very nature of speech perception (Jerger, 1973). The man aim of this study is to determine the perceptual symmetry most often seen in various dichotic nonverbal tasks is a fact or an artifact. Apart from knowing each ear’s efficiency in appreciating music it is worthile to study the performance in temporal lobe pathology cases. This might yield a clue in the proper diagnosis of patients with central auditory disorders.

Recently there have been studies by Sparks et al (1974) and Manohar et al (1975) which indicated improvement in aphasic language following Melodic intonation and Musical stimulation therapies. As Menon and Nandur (1975) have indicated, dominance for music could be used as an efficient channel through which language teaching could be effectively carried out.

Stuttering still is mystery. No definite conclusions have been drawn regarding its origin and development. The present study is aimed at obtaining basic data on their auditory cortical mechanisms involved in the perception of music.

Similarly, an attempt is made to determine whether trained musicians differ in any way from the normals in their performance on this test. It might throw more light as to how professional musicians perceive music.

Limitations of the Study

1) For want of time, the number of subjects in each group was kept to a minimum and the age range in each group was restricted.

2) Confirmed Brian damaged cases and aphasics were not included in the study for their non availability.

3) Different categories of trained musicians could not be tested as they were not available nor could varying amounts of training or intensity of training be quantified and compared.

4) The study is limited to only one kind of distortion.

5) The task involved both storage and perception. However no analysis was made of this. The study of perception versus storage mechanisms was beyond the scope of this paper.

Definitions

Dichotic Stimulation	:	Both ears are stimulated but each ear receives a different message from well separate channels of a tape recorder via earphones.
Test Ear	:	The ear receiving distorted pieces of tunes.
Reference Ear	:	The ear receiving constant piece of tune.
Stutterers	:	Stutters are those whose speech is characterized by repetitions, hesitations and prolongations of sounds and syllables with or without secondaries. They should have been so diagnosed by qualified speech pathologist.
Trained Musicians	:	Trained musicians are those who have undergone formal training in music for at least 4 years.

CHAPTER II

REVIEW OF LITERATURE

The left brain or, to state the matter more traditionally, the left hemisphere of the human brain, is for talking. It is not that the right hemisphere is incapable of listening, or even of doing whatever the brain needs to do for talking, but rather that each of the hemispheres id different in regard to the events to which it listens and possibly also the content each controls in talking. In the broadest sense, the differences between the brains (hemispheres) are along these lines. For almost all of us, whether we are right-handed or belong to the sinistral (left) minority, the left brain processes the kind of auditory events which constitute speech or human utterance. The right brain is the processor of music, of mechanical noises, and of the other environmental auditory non-speech events. (Eisenson, 1969).

Dichotic Studies with Linguistic and Non-linguistic Stimuli

Several investigators support the observation that the difference between the left and right temporal lobes of man are functionally different in regard to the kind of auditory events each processes. These investigations have employed a new technique, that of dichotic listening, which was devised by D.E. Broadbent (1954) of England. The Broadbent dichotic listening technique in effect sets up competition between the ears for the reception of signals. Basically, as devised by Broadbent, different digits are presented simultaneously to a listener’s ears by means of a dual channel tape recorder with stereophonic earphones. Groups of digits are presented, one sequence to one ear while another sequence is presented simultaneously (competitively) to the other ear. The subject is required to report all the digits he can recall in whatever order in which he can recall them. Since the investigator knows the ear to which the digits were presented, the report of the subject provides separate scores for the recall ability of each of the ears. The usual finding for normal right-handed persons is a statistically significant greater recall for the digits presented to the right ear than for those presented to the left. The explanation for the dichotic listening findings is that though both ears have neural connections to both sides of the brain, each ear has grater neural representation - -more nerve connections –in the hemisphere opposite to it than in the ipsilateral hemisphere. This certainly seems to be the case for the recall of digits and, more generally, for verbal (speech) signals.

Kimura (1961a), Milner (1962) and Studdert-Kennedy and Shankweiler (1970) postulate from dichotic stimulation studies.

that the left temporal lobe is predominant for verbal acoustic functions, especially in the extraction of consonantal features (Studdert, Kennedy and Shankweiler, 1970), but the right temporal lobe predominates for functions related to non verbal acoustic stimuli like music and sonar pulses (Milner, 1962; Kimura, 1964; Chaney and Webster, 1966).

Kimura (1961a) used Broadbent’s dichotic format to study patients with temporal lobe disorders. She demonstrated that when different digits are presented simultaneously to the two ears, the following results are obtained:

1) Unilateral temporal lobectomy impairs the recognition of digits arriving at the ear contralateral to the removal.

2) Overall efficiency, as measured by the total number of digits reported from both ears, is affected by left temporal lobectomy but not by right temporal lobectomy. Patients with lesions of the left temporal lobe, before and after surgery, were inferior to those with lesions of the right temporal lobe even when the groups had been previously equated for digit span.

She interpreted these facts to mean that the crossed auditory pathways in man were stronger or more numerous than the uncrossed auditory pathways and that the left hemisphere was more important than the right hemisphere in the perception of spoken material. Since this initial report. studies by Sinha (1959), Kimura (1961a, 1967), Milner (1962, 1967), Katz (1962, 1968), Katz, Basil and Smith (1963), Satz, Achenbach, Pattishall and Fennel (1965), Curry (1967), Milner et al (1968), Sparks and Geschwind (1968), Darwin (1969), Studdert, Kennedy and Shankwiler (1970) and others have supported this superficially simplistic conclusion.

While some writers argue that right ear supremacy can be overcome by having patients focus on left ear information (Wilson et al 1968), all agree that when patients have lesions of the temporal lobe, the ear contralateral to the lesion generally performs much more poorly than the ear ipsilateral to the lesion in the dichotic competing message task.

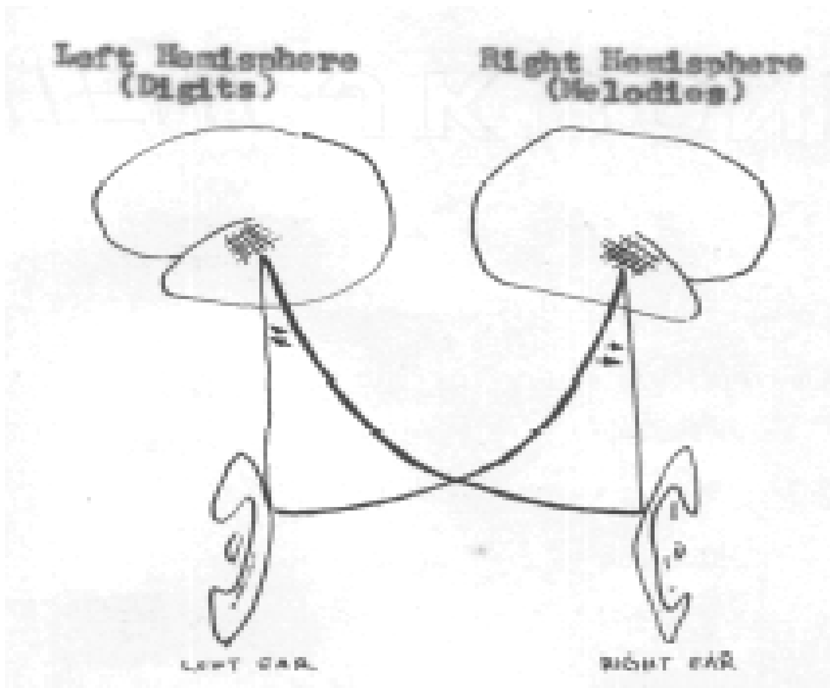
Effects of intensity on dichotically presented digits was studied by Roesen et al (1972). 32 normal hearing subjects have listened to digits dichotically presented at 10, 30, 50 and 70 dB SL. There was a significant tendency for subjects to report fewer correct responses at 10 dB SL. Subjects reported more stimuli from the right ear across intensity but results did not show right ear laterality to differ significantly as a function of sensation level.

If the left brain is for listening and processing verbal events, what is the function of the right brain in regard to auditory events? The evidence indicates that the right brain is the processor of non verbal content, or stated more conservatively and in keeping with experimental findings, the perception of non verbal auditory stimuli such as musical tones and tonal patterns depends more on right hemisphere (temporal lobe) activity than it does on left temporal activity (Eisenson, 1969).

Kimura (1967) reported on the results of a melodies test presented dichotically to 20 normal subjects. Two different melodies were presented dichotically which subsequently had to be selected (identified) from a group of four melodies, two of which had not been presented. Kimura found that a significantly greater number of accurate identifications were made for the left ear than for the right (75% compared with 63%). Results on subjects with temporal lobe pathology support the observation relative to the processing of non verbal events by the right temporal lobe.

Milner (1962) reported that performance on some subjects of the Seashore Measures of Musical Talents, e.g., tonal pattern perception is affected by right temporal lobectomy but not by lobectomy of the left temporal area. Similar findings in regard to impairment for melody for patients with right temporal lobectomy are reported by Shankweiler (1966). Specifically, Shankweiler found that perception of dichotically presented melodies was selectively impaired by the effects of right temporal lobectomy whereas perception of digits was selectively impaired by the effects of left temporal lobectomy.

A rather dramatic difference between the functions of the two ears, and so of the brains, comes to us from a study by Minor, Taylor and Sperry (1968). They employed the dichotic listening technique to investigate the differential listening of right handed patents who had their two hemispheres disconnected by surgical sectioning in order to control intractable epilepsy. The subjects were unable to report verbal messages received by the left ear while different verbal stimuli are channeled simulatenously to the right ear. On the other hand, or perhaps, on the other side the right ear is unable to report non verbal events. Thus the investigators conclude “Dissociation between verbal and left hand stereognosis responses indicate a right left dichotomy for auditory experiences on the disconnected hemispheres.” Again, we may report that the right ear and the left brain re peculiarly adopted for hearing speech, and the left ear and the right brain for processing non speech events. A neuronautomical schema for the differences between the brains, and so, presumably the ears is presented in the diagram from Kimura's (1967) article.



(From D. Kimura, Functional Asymmetry of the Brain in Dichotic listening,
Cortex 3, 1967)

Lancker and Fromkin (1973) had devised an experiment to compare ear preferences in tone language speakers for three sets of stimuli; pitch differences within language stimuli (tone words in tone language, Thai), language stimuli without pitch differences (consonant vowel words on midtone) and pitch differences alone (hums). Their results demonstrate that tone words and consonant words are better heard at the right ear, while the hums show no ear preference. Preliminary results on English speaking subjects suggest that the consonant words give the usual right ear effect while the tone words and the hums do not. This study lead to the conclusion that pitch discrimination is lateralized to the left hemisphere when the pitch differences are linguistically processed.

Papcun et al (1972) had presented Morse code singles dichotically to Morse code operators and to subjects who did not know Morse code. Morse code operators showed right ear superiority indicating left hemisphere dominance for the perception of dichotically presented Morse code letters. Naïve subjects showed right ear superiority, indicating left hemisphere dominance (same as Morse code operators) when presented with a set of dot-dash patterns which was restricted to pairs including 7 or fewer elements, counting dots and dashes each as elements. But when presented with a list that contained longer stimuli, naïve subjects showed left ear superiority, indicating right hemisphere dominance; the opposite of their results with the shorter stimuli. They hypothesize that pairs consisting of the “magical” number seven or fewer elements are perceived with reference to subparts, of which they are composed, but that longer stimuli force naïve subjects to adopt strategies involving the holistic qualities of the stimuli. Consideration of these findings in the light of other literature on lateralization results suggests that language is lateralized to the left hemisphere because of its dependence on segmental sub-parts and that this dependence characterizes language perception as distinct from most other human perception.

Although man is born with the potential for differential hearing, the differences do not become established until about age four of five, usually somewhat earlier for girls than for boys. Interestingly, Kimura (1967) reports that children form high socioeconomic families in Montreal show earlier ear preference than do children from low socioeconomic groups. She also found that children with reading problems, especially Dr. Kimura states, “Apparently, the normal developmental lag is simply accentuated in boys with reading problems.”

Evidence from neurological centers strongly indicates that the dominance of the left brain for language functioning develops upto the time of adolescence (Lenneberg, 1967; Penfield, 1959). However, the brain as a whole continuous to be relatively plastic, so that in the event of damage to one side, the other seems capable of taking over many of the functions. Perhaps another and more conservative way of making this observation is that upto the age usually associated with the onset of adolescence, insult to either side of the brain as far as language and related functioning is concerned, produces temporary disruption. Following the period of disruption, there is a period of reorganization of cerebral functioning during which the hemisphere previously or presumably subordinate for language, takes over the functions of the formerly dominant hemisphere. Plasticity of the brain as manifest in control of cerebral functioning for language, is present at birth and continues upto adolescence. Normally, however, cerebral control or dominance for language is established by age four or five, and seems to be related to both hand and ear preference. Plasticity ends by about age twelve (Eisenson 1969).

Schulhoff and Goodglass (1969) present an orderly set of hypotheses to study the interaction between the side of brain lesion and words, tone sequences or click stimuli. They anticipated a contralateral ear effect in normals with respect to the dominant hemisphere, a decrement in performance at the contralateral ear is brain injured subjects, a bilateral decrement for recognition of words when left hemisphere is damaged and a decrement for musical tones when the right hemisphere is damaged. All of those effects would be seen along with a decrement in perception at the ear contralateral to the lesion.

They studies ten right brain injured and ten left brain injured as well as normal control subjects and felt they had demonstrated the anticipated effects. They felt they were seeing a “lesion effect”, where selectively grater impairment of report was seen from the ear contralateral to an injured hemisphere.

Cook (1973) studies the left right differences in the perception of dichoticaly presented musical stimuli. It is concluded that the number of musical phrases correctly recognized when presented to the left ear will be greater than those correctly recognized when presented to the right ear. These results are in accordance with earlier findings, Which pointed to the asymmetrical functioning of the brain lobes. Depending upon their type, aural stimuli are differentially interpreted by the two lobes. For right handed subjects, musical sounds appear to be processed more efficiently by the right lobe of the brain than the left.

Further supporting evidence is available from the experiments conducted by Blumstein and Cooper (1974) who concluded that the right the right hemisphere is directly involved in the perception of intonation contours and that normal language perception involves that active participation of both cerebral hemispheres.

Oscar-Berman et al (1974) believe that the obtained laterality effects, i.e., right ear superiority for verbal materials might be an artifact of the procedure, and might reflect unequal distribution of attention to the right ear rather than perceptual dominance (Inglis, 1963; Triesman and Geffen, 1968). That is, people may somehow develop a habit of listening first to the right ear (perhaps because of factors related to right handedness). However, if the phenomenon can be shown to change as a function of changing materials such that left ear reports are more accurate with non verbal stimuli, then the ear order effects cannot be ascribed just to habit or attentional patterns. Alternatively, perhaps two factors, perceptual laterality and attentional bias, may interact to produce the obtained results. Finally, Oscar-Berman et al (1974) conclude from their study that the storage mechanism may be more sensitive to laterality differences than the perceiving and reporting mechanism.

Spreen et al (1970) studied the ability of 48 university students to listen to musical stimuli dichotically. The experiment was based on the rationale that left ear stimuli are recalled better than right ear stimuli in dichotic experiments where music is the stimulus. Their results support a left ear superiority for musical stimuli; however the size of the difference between ears for music and tonal patterns decreased with the increasing length of the time interval during which the subject had to keep the two patterns stored in memory. At 12 seconds of waiting time, no significant difference between the ears was found. This suggests that the effect is one primarily of perceptual difference in efficiency of processing, rather than some special memory capacity of one hemisphere or the other (Berlin, 1970).

Further support for the above view is available from Spellacy (1970). In his study, 64 subjects selected on the basis of a right ear preference in the recall of dichotically presented words were tested in the recognition of four kinds of dichotically presented non verbal stimuli; music, timbre, frequency pattern and temporal patterns. Recognition was tested following 5 second and 12 second intervals. A significant left ear preference was shown in the recognition of musical stimuli following the 5 second interval only. The ear differences in the remaining stimulus conditions were not significant. Their results are interpreted as being consistent with a perceptual model of stimulus processing in dichotic listening.

Cerebral dominance and Stuttering

No discussion on cerebral dominance on Stuttering will be complete without referring to the Orton-Travis (1936) theory of stuttering on the basis of cerebral dominance. The basic cocnpet of this theory was developed by Orton I connection with reading, writing and speech problems in general. The essential element of this concept of cerebral dominance in connection with stuttering is related to the precise coordinations of many paired muscle groups which are innervated in different sides of the brain during the act of talking. Thus, to move the tongue for speech purposes, impulses must be initiated from both cortical hemispheres and then arrive simultaneously at nerve endings in muscles on both sides of that import oral structure. This demands and integration of activities between the two hemispheres, which was hypothesized as possible only if one of them was functionally dominant serving as a master control unit. It was thought that the majority of stutteres were people who lacked sufficient margins of unilateral dominance for proper coordination under all circumstances. If the margin was small (equilateral), stuttering would be triggered by relatively small amount of stress such as physical fatigue or emotional upset. As the margin approximated unilateral dominance, the individual was presumed to be less vulnerable to the triggering or precipitating conditions. In some cases, the confused laterality was believed due to an inherited system incapable of providing satisfactory unilateral motor leads of speech. Others acquired stuttering when the normal development of unilateral dominance was disrupted by certain environmental influences such as a forced changing of handedness.

Travis-Orton theory lost the status at once enjoyed because it could not explain several phenomena including the one in which stuttering is found in persons who have definite unilateral cerebral dominance for various functions including speech.

Curry and Gregory (1969) have conducted an experiment to study the performance of stutterers on dichotic listening tasks, which are thought to reflect cerebral dominance. Twenty stutterers and twenty non stutterers were given one monotic verbal listening task and three dichotic listening task. One dichotic task was verbal and two were non verbal. The non-stuttering adults showed an expected tendency to be better with their right ear in the dichotic word tasks. The stutteres, however, showed no laterality effect in favour of the left hemisphere or right ear. These workers were circumspect in their interpretations but guessed that differences between stutterers on this task may involve one or more of the processes implied by such terms as cerebral dominance, perception, feedback, etc.

Tsunoda and Moriyama (1972) had administered Tsunoda's cerebral dominance test and standard audiometry on adult stutterers with the aim of examining the central auditory mechanism of stutterers. On the cerebral dominance test 79.3% of normal controls showing dominance of vowel sounds in the right ear and of non verbal sounds in the left ear but this pattern existed for only 38.6% of the stutterers. Among stutterers 29.6% showed dominance for vowel sound in the left ear and of non verbal sound in the right ear (converse from normal), while 20.5% showed dominance of both vowel and non verbal sounds in the right ear, thus is characteristic of an impaired temporal lobe on one side as in aphasia and 4.5% showed right ear dominance. This relation had no relation to handedness. These results suggest that among stutterers there is a subgroup for which stuttering may be due to abnormal cortical functioning resulting from minimal brain damage.

Cohen and Hanson (1975) compared the efficiency of intersensory processing between fluent speaks and stutterers. They believe that inefficient performance on auditory visual tests of intersensory integration to be a sensitive indicator of certain specific types of cerebral dysfunction which cannot be detected by standard neurological examination. Their results indicated that the stutterer’s performance on this particular intersensory integration task was significantly lower than that of their fluent peers. This finding is interpreted as supporting the theory that the cortical organization of stutterers might somewhat be different from and less efficient than that of fluent speakers. Stutterers would seem to possess some type of specific neurological dysfunction which prevents or interferes with their ability to perform efficiently in receptive functions such as intersensory integration as well as in the expressive skill of fluent speech.

However, contradictory evidence has been reported by Dorman and Porter (1975). Sixteen adults, right handed, moderate to severe stutterers and 20 non stuttering controls were given a dichotic nonsense syllable test to determine hemispheric specialization for speech. Both male and female stutterers evidence right ear advantages in syllable identification similar in magnitude to those found in normals. These data confirm other reports of no difference in cerebral speech lateralization for stutterers and non stutterers and, therefore, lend no support to theories that relate stuttering to abnormalities in cerebral lateralization.

Cerebral Dominance in Musicians

Only one study has been reported in the available literature which throws light on this topic. Bever and Chiarello (1974) had compared the cerebral dominance in musicians and non musicians. They report that musically experienced listeners recognize simple melodies better in the right ear than the left, while the reverse is true for naive listeners. Hence, contrary to previous reports, music perception supports the hypothesis that the left hemisphere is dominant for analytic processing and the right hemisphere for holistic processing.

CHAPTER III

METHODOLOGY

To investigate ear preference for music, a test has been developed, based on a pilot study.

Test Material

It consisted of Western classical tunes, purely instrumental in nature with no verbal component and hence these were classified as non verbal stimuli. These tunes were selected so as to reduce the familiarity and thus to make it difficult for the subjects to identify and label them.

Recording

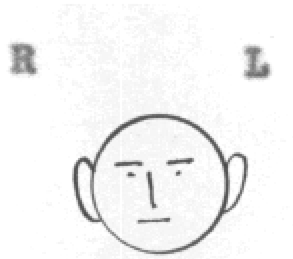
The test consisted of 13 events, including 3 control events.

A typical test event consisted of a constant undistorted tune in one ear and 3 varying distorted tunes in the other. Since the presentation had to be dichotic, the constant tune was recorded on Track I (3 times) and distorted tunes on Track II. Thus, in the first part of the event there was an undistorted (constant) tune in one ear and the other ear received the first of the 3 distorted tune. Then, in the second part of the event the constant piece of tune was repeated in that ear whereas the other ear gets the second of the distorted tunes. In the final part of the event, the constant piece was again repeated while the other ear receives the third of the 3 distorted tunes. In a test event, it has been so arranged that a part of one of the 3 distorted tunes, closely resembles the constant piece of tune played in the contralateral ear.

This pattern (constant, undistorted on Track I and different distorted on Track II) was maintained throughout the preparation of the test spool. Great care was taken to maintain the synchrony between the two tracks. This synchrony was verified by using a dual channel Storage Oscilloscope (ECIL type 0S768 – S).

The duration of each tune was 10 seconds. There was a 3 seconds gap between two tunes within the events. Between the events a 6 second interval was maintained, to facilitate scoring. The experimental paradigm could be better understood by the following schema:

TRACK I			TRACK II	
A	Constant		Different	Ad
A	Undistorted		Distorted	Bd
A				Cd



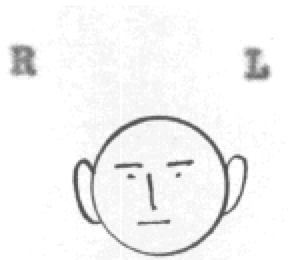
DICHOTIC PRESENTATION

TUNES -	A . . . . Ad	(10 seconds) on time
	. .	(3 seconds) off time
TUNES -	A. . . . . Bd	(10 seconds) on time
	. .	(3 seconds) off time
TUNES -	A. . . . . Cd	(10 seconds) on time
	. .	(6 seconds) off time for scoring

The above schema clearly represents a test event. Note that one of the 3 distorted tunes, namely, Ad would be the one which closely resembled the constant piece of tune A at lest to a small extent. The subjects were required to identify this and score accordingly. There were 10 such test events. The position of the correct distorted tune was varied from event to event by randomization.

The test also consisted of 3 control events, which had been inserted, at random, among the 10 test events. According, event numbers 4, 8 and 11 were control events. These were comparable to “catch items” and it could be found out whether the subject’s response was true or false. In a control event there is no resemblance between the constant piece of tune on Track I and the three distorted tunes on Track II. In other words, the distorted version of constant tune was not present on Track II, but a totally different tune was distorted and recorded on Track II. Subjects were required to indicate that there is no resemblance between the constant piece of tune (undistorted) in one ear and 3 distorted tunes in the other ear and score accordingly. Again a control event could be depicted as follows:

TRACK I			TRACK II	
Y	Constant		Different	Sd
Y	Undistorted		Distorted	Td
Y				Ud



DICHOTIC PRESENTATION

TUNES -	Y . . . . Sd	(10 seconds) on time
		(3 seconds) off time
TUNES -	Y. . . . . Td	(10 seconds) on time
		(3 seconds) off time
TUNES -	Y. . . . . Ud	(10 seconds) on time
		(6 seconds) off time for scoring

It is clear from the schema that the distorted tunes recorded on track II are different from the constant piece of music recorded on track I. Since there are four different tunes, there is found to be no resemblance between the piece of tune and the 3 distorted tunes, even to a small extent.

The recording was done using a Philips record player (with there speeds, 33, 45 and 78 rpm) and a Uher Stereo tape recorder (Type: Variocord 263) through line connections. The constant tune on Track I was recorded, when the disc was played at normal speech (i.e. 33 rpm) and to achieve distorted tunes on the other Track, the dises were played at maximum speech (i.e. 78 rpm). This pattern was maintained throughout the preparation of the test spool. As indicated earlier, the synchrony between the Tracks was verified by using a Storage oscilloscope (ECIL type OS768-S).

The whole recording was made with the speed of the tape recorder being set at 3 ¾ inches per second, the frequency response at this speech being 30 – 15000 Hz.

Equipment and Test Environment

The type was played using Uher Stereo tape recorder (Type Variocord 263) via a calibrated Madsen (OB70) _ clinical audiometer with TDH 39 earphones fitted with circumaural cushions. The output of the type recorder was connected to the two independent channels of the audiometer and thus the presented level in each ear could be separately controlled.

The experiment was always conducted in a two room set up. The subject was seated in a sound treated booth which fulfilled the levels prescribed for audiometric purpose. The test room was devoid of any charts or any other probable distractions.

Subjects

Three groups of subjects have been tested in the present study.

Normals: 25 males and 25 females. All were right handed with normal hearing (screened at 20 dB HL – ISO 1964). Their age ranged from 18 to 28 years with a mean age of 22.50 years.

Stutterers: 10 adult male stutterers. Severity of their speech problem varied from mild to severe. All were right handed with normal haring (screened). Their age range was from 19 to 25 with a mean age of 24.3 years.

Trained Musicians: 10 adult female trained musicians, who had at least 4 years of formal training in music. All were right handers with normal hearing (screened). Their age ranged from 18 to 26 years with a mean age of 23 years.

Procedure

In the present study, instructions and procedure were standardized after pilot trails.

Prior to the administration of the test, each subject was given a data sheet to fill in the necessary details. For determining handedness, three factors were considered: Writing hand, Clasp test and Subjective report was obtained, as an indicator of handedness. However, discrepancy was observed in only 6 subjects, who were later confirmed as right handers.

Instructions

“You will hear a piece of music in each ear simultaneously. In your right ear the piece of music is constant for three trials during which the left ear receives three different pieces of music. This constitutes one event. You have to identify as to which of the three different pieces of music of the left ear closely resembles the one in the right ear. Please listen attentively to all the three trails in an event before making your choice. Indicate your choice by making a tick (✓) mark in the appropriate column. For example, if the second piece of music in the left ear closely resembles the piece of music in the right ear, make a tick mark in column 2. If you think there is no resemblance between the pieces of music in the left ear and the one I the right ear, make a tick mark in column 4.

In total you will be given 13 events.

If you have any doubts, please ask now"

This is one of the two sets of instruction prepared. The other contains the same instructions but with a reversal of stimuli in each ear. Thus, these subjects would receive the constant piece of tune in the left ear and the 3 distorted tunes in the right ear.

Half the subjects in each group were given the former mode of presentation first (R – constant, L –different), the other half getting latter mode of presentation (R – different, L – constant), so that any remaining asymmetries in the tape or apparatus were counterbalanced over ears. Throughout the test subject was discouraged from selectively attending to one ear.

After the presentation of 13 events, the earphones were interchanged and the whole tape was played back once again. The first session takes nearly 209 minutes and another 20 minutes are needed when the earphones are interchanged and the second session to be completed.

Prior to the administration of the test, the test tape was played for some time and each subject was asked to indicate whether the loudness of tunes in both ears was the same or different. If any discrepancy in loudness was reported, then the intensity of the specific channel was manipulated till the subject reported that the tunes in both ears were of equal loudness. Once there levels were obtained, the whole test was presented at these determined levels. It should be noted that the test was presented at a comfortable level, not a specific intensity level. The presentation level for all the subjects was in the range of 60 to 75 dB HL.

Scoring

Two scoring sheets were given separately, one for each session. Immediately at the end of the first session the scored sheet was taken and a blank scoring sheet was given for the second session. This was done to see that the subject does not use the results of the first session in the second session.

The subjects were asked to respond by making a tick mark in one of the four box 1, when the first one of the three distorted tunes in one ear was thought to resemble the constant tune in the other, the second box was to be marked when the second tune was thought to resemble the constant one and the third box should be marked when the last of the three distorted tunes resembles the constant tune. If no resemblance was observed by the subject then box 4 was to be marked. The scoring sheet looks like for following one:

Scoring Sheet – Test for Ear Dominance

Event	1	2	3	4
I				
II				
III				
IV				
V				
VI				
VII				
VIII				
IX				
X				
XI				
XII				
XIII				

Since the test events were 10, the number of correct identifications were converted to percentage score. The test ear is taken to be the ear which receives the 3 different distorted tunes. No score was attributed if a control event was correctly identified. However, a note was made as to how many control events were detected by each ear.

Criteria for Retest

Reset was given to those subjects who performed in the following manner on this test:

a) If one of the ears does not identify a single test event (in other words, if one of the ears obtains a score of 0%).

b) If not a single control event was identified in both the sessions (since each session has 3 control events, there are two sessions and if a subject fails to identify one out of six control events).

Those who scored correctly on one or more events in the test in both ears and correctly on at least one control event out of six presented were deemed to have passed and no retest was done for them.

Reliability Check

10 normal subjects were picked at random and were re-administered the test after a lapse of 15 days from the date of the initial test administration. All these subjects passed the test at the first attempt. When subjects were taken for retest of reliability, the order of presentation of the tests was also repeated.

CHAPTER IV

RESULTS AND DISCUSSION

Appendix I gives the percentage scores of normal subjects (Male and Female) and Appendix II gives the score obtained by Stutterers and Trained Musicians.

Table I gives the performance of the different groups for each ear. Since obtained distribution was not a continuous one (in other words, it was a discrete distribution), non parametric measures were applied. The test which was used to determine the significance of difference was the Wilcoxson Matched-Pairs Signed-Ranks test. It makes use of paired observations in magnitude as well as direction.

Using the above test, ear differences for each group were tested for significance. To verify the first hypothesis, the differences between Right and Left ears in normals was tested. The obtained Z value (4.1) was significant at the 0.01 level, thus rejecting the null hypothesis. It was conduced that in normals, the Right and Left ears differ significantly in their performance on this test.

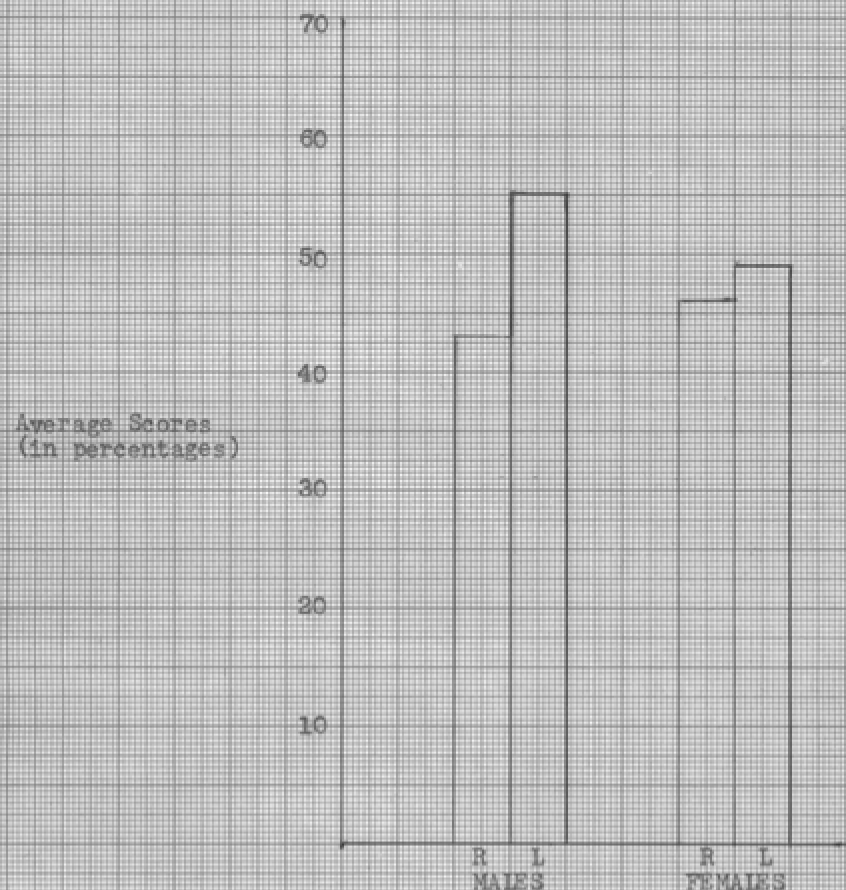
Table I showing the Performance of the different groups for each ear

	NORMALS				**STUTTERERS**		**TRAINED MUSICIANS**	
	Males		**Females**					
	R	**L**	**R**	**L**	**R**	**L**	**R**	**L**
Total	1080	1380	1150	1220	420	460	350	370
N	25	25	25	25	10	10	10	10
MEAN	43.20	55.20	46.00	48.20	42.00	46.00	35.00	37.00
S.D.	11.80	21.24	13.84	19.00	15.49	22.21	17.16	15.67

As expected, there was no significant difference between the performance of Males and Females. Both sexes exhibited a significant left ear preference, but the magnitude was greater in Males. The obtained Z values for Males and Females were 0.83 and 2.71 respectively, both significant at the 0.01 level implying that both sexes do not differ significantly in their performance on this test. Thus the second null hypothesis was accepted. Graph I shows the performance of the two sexes on this test.

Both Stutterers and Trained Musicians differ significantly from Normals on this test. The obtained T values were 14.5 and 12.5 respectively, implying that there was not significant difference between Right and Left ears, in these two groups

Graph I showing the average performance of the two sexes
for both ears



(at the 0.01 level). So the null hypothesis, “In Stutterers, there is no significant ear preference for the perception of music” has been retained.

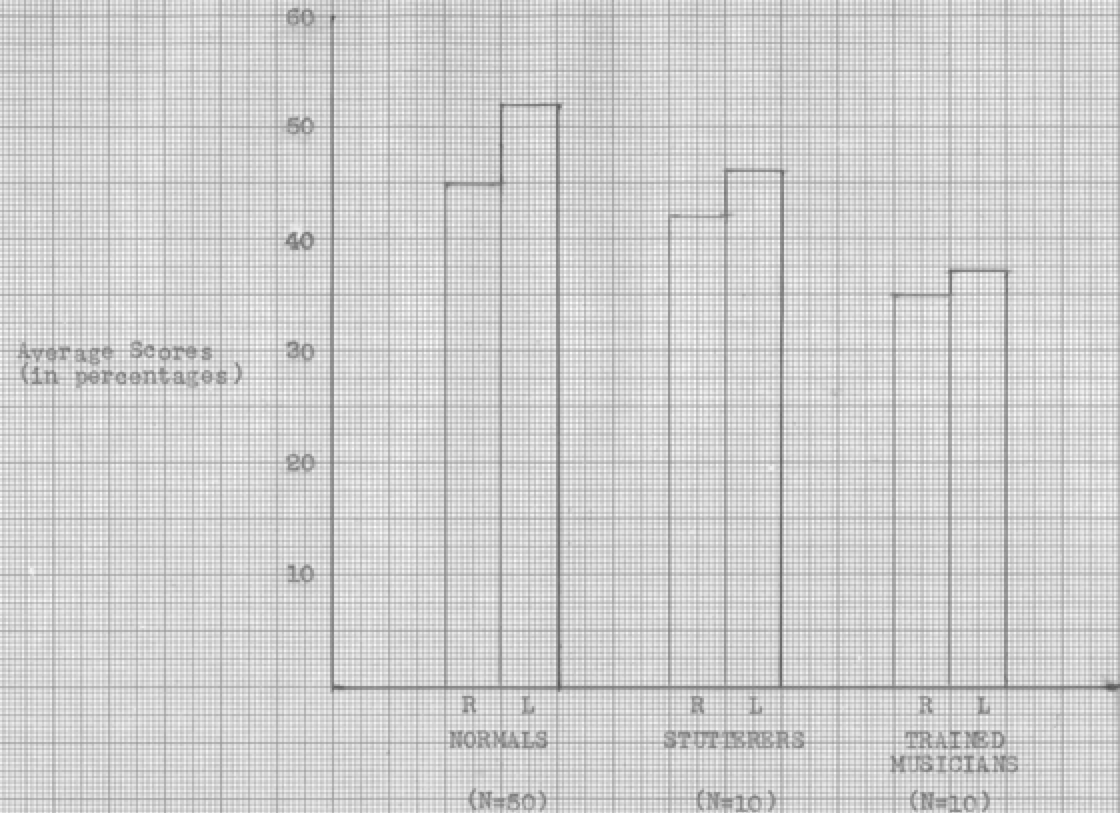
As already indicated, even Trained Musicians did not exhibit a significant ear preference. Contrary to the expectation they performed poorly, compared to Normals. So the last hypothesis, “Trained Musicians do not differ significantly from Normals with references to ear preference for music” was rejected.

Graph II shows the average performance of each group for the two ears. It is interesting to note that in each group, the mean left ear score was higher than the mean right ear score.

Table II showing the percentage of subjects exhibiting Greater left ear score, Greater right rear score and Equal scores for both ears

Group		**Greater left ear score**	**Greater right ear score**	**Equal scores for both ears**
Normals	Males	60	28	12
	Females	44	44	12
Stutterers		60	20	20
Trained Musicians		40	30	30

Graph II showing the average performance of each group for the two ears



The data for two ears were also separately analyzed and the following results arrived at. Meals and Females showed a slight difference in both the ears (Z= 0.24 for the right ear and 1.63 for the left ear, both significant at the 0.01 level). This trend was also found in the other groups.

Table II indicates the percentage of subjects exhibiting a Grater left ear score, Greater right ear score and Equal scores for both ears. At a superficial level, it is evident that the percentage of Stutterers and Normal Males, having higher left ear score was the same and similarly the percentage of Trained Musicians and Normal females having a greater left ear score was nearly so. However, the distribution of subjects according to a greater right ear score shows no such sex differences, the percentages of the Trained Musicians and the Normals males being nearly same. Finally a greater percentage of Trained Musicians had equal scores for both ears than did the other groups.

Table III shows the range of percentage scores for each ear in each group. The maximum score for the left ear was 80% (in Normal males and females) and the minimum was 10% (in Normal males and Stutterers). The maximum score obtained for the right ear was 70% (in Normal females and Trained Musicians), whereas a minimum score of 10% was observed in stutterers. Once again, it is evident that both Normal males and Stutterers have similar range of scores and so also the Normal females and Trained Musicians.

Table III showing the Range of scores (in Percentages) for each ear in each group

Group		RIGHT EAR		LEFT EAR	
		Maximum	Minimum	Maximum	Minimum
Normals	Males	60	20	80	10
	Females	70	20	80	20
Stutterers		60	10	70	10
Trained Musicians		70	20	60	20

Test-Retest Reliability

Test-Retest reliability was established on ten normal subjects, selected at random. The finings are given in Appendix III. The Product moment correlation was computed, using the initial and retest scores of the two ears. A high reliability coefficient of 0.88 was obtained. A high test-retest correlation for a dichotic listening test was also reported by Pizzamiglio et al (1974).

The results suggest that in normals, the left ear is better equipped to process music than the right ear. These findings fall in line with those in Milner (1962), Kimura (1964, 1967), Shankweiler (1966), Chaney and Webster (1966), Schulhoff and Goodglass (1969), Spellacy (1970), Spreen et al (1970) and Cook (1973). It is assumed that the left ear-right hemisphere combination is more efficient in processing music. This is viewed as an additional support for Kimura’s (1961a, 1964, 1967) hypothesis regarding the strength of crossed auditory pathways.

As mentioned earlier Stutterers had no significant ear preference for music. Their performance on this test was below that of normals. It was believed that their cortical functioning was different from that of normals and the performance of Stuttering on this test suggest that this is so. Whether stuttering originates because of this apparent abnormal cortical functioning or not was not clear. These results obtained are in accordance with the results obtained by Curry and Gregory (1969) and the conclusions drawn by Tsunoda and Moriyama (1972) and Cohen and Hanson (1975).

Contrary to the finings reported by Bever and Chiarello (1974), Trained musicians did not exhibit any significant ear advantage. In fact, their performance was much poorer than the normals. However, further corroboration of these findings is necessary, employing larger samples and more stringent control of all the variable involved.

CHAPTER V

SUMMARY AND CONCLUSION

Based on a pilot study, a test was developed with 13 events out of which 10 were test events and 3 were control events. In each test event one ear gets a constant piece of tune and the other ear receivers the distorted version of the constant tune and two other distorted tunes, one at a time in a dichotic fashion. After listening to the whole event, the subject was asked to find out as to which one of the three distorted tunes resembles the constant piece of tune in the other ear. I a control event, the distorted version of the constant tune was not present and it was replaced by another distorted tune. The subject was expected to indicate that there was no resemblance between the constant and the three distorted tunes.

First, each subject was present the 13 events and then the earphones were reversed and the whole tape was played back. The total number of correct identifications from 10 test events was converted into the percentage scores. Always, the ear receiving constant piece of tune was taken as the reference ear and the other ear receiving distorted pieces of tunes was taken as the test ear.

Three groups of subjects were tested in the present study – 50 normals (25 Males and 25 females), 10 Stutterers and 10 Trained musicians. Their ear preference for music was compared.

CONCLUSIONS OF THE STUDY

1) In normals, there was a significant difference between the two ears for the perception of music.

2) Both Normal males and Normals females had a significant ear preference, however, the magnitude of preference was greater in Males.

3) There was no significant difference between the two ears in Stutterers and Trained musicians. Stated alternatively, these groups of subjects did not exhibit a clearcut ear preference.

4) The results of the test-rest reliability on Product Moment Correlation showed a high Correlation of 0.88 between the test and retest scores.

SUGGESTIONS FOR FURTHER RESEARCH

1) A large sample of subjects with a greater age range, in each group, could be studied.

2) The effects of intensity variations on ear preference may be examined.

3) The effects of various types of hearing impairment on ear preference may be studied.

4) Aphasic and Brain damaged patients could be tested for ear preference and their performance could be compared with the performance of Nomals.

5) Different categories of Trained musicians, with varying amounts of training may be studied for Ear preference for Music.

Appendices

APPENDIX I

Table showing Percentage scores of 50 Normals subjects (25 Male and 25 Female) for Right and Left ears

Sl. No.	MALES		FEMALES	
	R	L	R	L
1	60	80	30	60
2	50	50	40	40
3	30	10	60	80
4	40	70	60	50
5	20	60	70	50
6	40	40	40	40
7	40	20	50	70
8	40	30	60	20
9	50	70	70	40
10	30	70	30	20
11	40	30	50	30
12	60	80	40	70
13	30	60	60	60
14	60	40	40	20
15	60	40	40	30
16	40	70	20	50
17	50	70	60	50
18	50	70	20	50
19	40	80	60	20
20	60	90	40	70
21	40	20	40	70
22	50	50	40	70
23	40	70	40	60
24	20	50	50	30
25	40	70	40	70

APPENDIX II

Table showing percentage scores of Stutterers (N = 10) and Trained Musicians (N = 10) for Right and Left ears

Sl. No.	**Stutterers**		**Trained Musicians**	
	R	**L**	**R**	**L**
1	10	10	30	30
2	60	20	50	20
3	50	50	50	50
4	20	50	40	60
5	50	70	20	60
6	50	70	30	20
7	50	70	70	40
8	40	50	20	20
9	40	50	20	30
10	50	20	20	40

APPENDIX III

Table showing Test-Retest Reliability

Sl. No.	Test		Retest	
	R	L	R	L
1	70	50	70	40
2	40	40	40	40
3	70	40	70	50
4	20	30	20	30
5	30	40	40	40
6	40	50	40	50
7	40	20	40	30
8	60	70	70	80
9	50	60	70	80
10	50	50	50	40

Reliability Coefficient = 0.88

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