SPEECH LATERALIZATION IN THE RETARDED CHILD: AN INVESTIGATION OF CEREBRAL DOMINANCE AND AUDITORY PERCEPTION OF VERBAL STIMULI

By

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Finally, this thesis is dedicated to the mentally retarded, as a continuing effort in assisting them in leading a more normal and purposeful life.

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CHAPTER I

INTRODUCTION AND REVIEW OF THE LITERATURE

Throughout the history of medical and psychological research there have been continued investigations into the structure, function, and processes of the human brain. Of particular interest to researchers concerned with the development and function of speech and language processes is the finding that speech and language functions appear to be centered in the left cerebral hemisphere, in the area of the inferior frontal and pre-central gyri. Branch, Milner, and Rasmussen (1964) estimate that 90% of normal right-handers and over 60% of normal left handers have speech functions represented in the left cerebral hemisphere. Previous methods of determining this hemispherical dominance (for purposes of speech and language) have, until recently, relied on clinical observation and surgical techniques. In 1954, however, Broadbent began a series of experiments which have led to an accurate non-surgical method of determining cerebral dominance. The basic experimental procedure was a psycho-acoustic phenomenon termed dichotic listening, dichotic referring to the division of the two hemispheres. His procedure consisted of presenting words to the two ears in a simultaneous manner, each ear hearing a different word.

Subjects were then asked to repeat the two stimuli. Broadbent found, following a series of such presentations, that for most subjects the right ear demonstrated a higher percentage of correct responses, indicating better perception of stimuli presented to that ear. Since then, Kimura (1961 a-b, 1963, 1967a), and several others (Bryden, 1963; Carr, 1969) have found a similar right-ear effect. Kimura (1961a) and Broadbent (1954) explained this right-ear effect as being a reflection of cerebral dominance. Since it had been shown earlier that for most individuals the left cerebral hemisphere is dominant for speech and language, Kimura (1961b) concluded that right-ear superiority in the recognition and recall of verbal stimuli demonstrates stronger contralateral than ipsilateral connections between the ears and the brain hemispheres.

Kimura (1961a) conducted numerous experiments with the dichotic task in relation to auditory perception. In a study of subjects evidencing temporal-lobe damage, she found that lesions of the left temporal lobe impaired overall performance on the dichotic digits task. These patients had a smaller total number of correct responses than did those with lesions of the right temporal lobe. This difference between the two groups was present before surgery and was more pronounced after surgery. She reported that her findings were consistent with other reports that lesions of the left temporal lobe impaired the ability to assimilate verbal auditory material (Kimura, 1967a).

She goes on to say:

> "...before operation regardless of the site or side of the lesion, more digits were accurately reported from the right ear than from the left ear, by all patient groups. The same effect was found in normal subjects as well (Kimura, 1961b)...The score was higher for the ear opposite the dominant hemisphere than for the ear ipsilateral to it." (Kimura, 1967a).

Thus, Kimura concluded that in most cases the left temporal lobe evidently has some critical functional role in the perception of selected spoken material which the right temporal lobe does not share. This theory of lateralization has subsequently been upheld by a number of clinical investigations, (Meyer and Yates, 1955; Milner, 1958) and the dichotic listening task is widely accepted as an accurate method of determining cerebral dominance.

Development of Cerebral Dominance

The age at which cerebral dominance becomes established for purposes of speech and language has long been an area of concern. Authorities such as Zangwill (1960) have hypothesized that left cerebral dominance is established gradually during childhood, as evidenced by the ability of children who have suffered some type and degree of left-sided brain trauma, even as late as age six or seven, to recover speech functions by relying on the right hemisphere. Furthermore, lesions of the right hemisphere result in aphasia more frequently in children than in adults (Basser, 1962), suggesting some participation of the right hemisphere in speech functions of the child. As will be seen, however, the results and data from dichotic listening studies on children suggest that the left hemisphere generally is predominant for speech functions at an early age.

Kimura (1963) conducted a study of development of cerebral dominance in young children and found that children as young as five years of age evidenced a right-ear effect for both sexes. These children were all from a well-to-do residential area, with many of the parents working in a professional environment. She repeated the study with four-year-old children in a comparable area and found again that both boys and girls evidenced a significant right-ear effect. While this would appear to be at odds with the previously mentioned studies which cite evidence of right cerebral functioning for speech and language at ages six and seven, Kimura points out that merely because the left hemisphere is predominant for purposes of speech and language functioning in the young child does not rule out the participation or potential of the other hemisphere in these functions. Apparently, however, when injury occurs at an early age, other areas of the brain are better able to substitute for the speech areas than when injury occurs later in development.

Kimura subsequently repeated the study with children from a low-to-middle class socio-economic area, and found that although the five-year-old girls showed a significant right-ear effect, the five-year-old boys did not. The boys evidenced a trend for the right ear to be superior, but it was not statistically significant. The following year, a research assistant repeated the study in a comparable school, and found essentially the same results. Kimura thus feels that if one tests children at an early enough stage of development, a sex difference in the development of cerebral dominance may be detected, but she cautions that there is no information or evidence to indicate which of the many potential factors such as intelligence level, home background, and verbal ability, for example, may account for this possible sex difference. Apparently, there have been no subsequent investigations of this possible sex difference.

The Problem of the Retarded

The findings described above appear to be readily observable when studied in the normal population, where normative levels for speech and language functioning have been established. Little is known, however, about establishment of lateralization of speech and language functioning in the retarded population.

Neufeldt (1966) conducted extensive experiments with retarded subjects. He hypothesized in part, that.....

(1) retardation occurs because the subject has difficulty with information retrieval, or...
(2) retardation occurs because the subject has difficulty with information acquisition.

Neufeldt felt that this latter condition would be a problem of short-term-memory and that it can be tested. He speculated that as the subject receives the dichotic stimuli, he channels it into two systems. Those digits which the subject begins to report are thought to have been perceived and immediately fed back, without ever having been stored or retained in any memory system. The latter half of the digits reported are thought to have been stored in a short-term-memory system, and failure to report some or all of these digits is due to a breakdown or decay of the short-term-memory system. His experiments investigated this basic hypothesis, by varying the amount of stimuli, the rate of presentation of stimuli, and finally, the type of stimuli. The primary purpose of the experiments was to determine whether or not short-term-memory capacity and/or strategy of encoding information could account for some of the differences between retardates and normals.

The subjects for his study consisted of four groups: two groups of retardates, one organic and one cultural-familial in nature; two groups of normal controls, one matched with retardates in mental age, and the other matched with retardates in chronological age. Neufeldt observed the following results:

Experiment 1. The effective short-term-memory capacity of both the retarded groups was slightly less than that of the matched mental age control group. Their capacity, however, was much less than that of the matched chronological age group. His results indicated that the two retarded groups were subject to faster rates of information decay. In analysis of the data, the results suggested that as information load increased, i.e., by increasing the number of digits presented in series, subjects were prone to change in strategy from recalling the digits ear by ear (ear order), to other types of strategies regarded as generally less efficient.

Experiment 2. At rapid rates of digit presentation, normal subjects tended to report the numbers received from one ear followed by the numbers received from the other ear. As the rate of presentation slowed, however, the frequency and accuracy of reporting the stimuli in other orders (such as the order in which the information is perceived) increased. This shift in order of reporting was observed for some subjects in the cultural-familial group, but was not observed for any subjects in the organic group.

Experiment 3. This experiment varied the type of dichotic stimuli presented. Each pair of items simultaneously presented consisted of a letter of the alphabet and a digit. The side on which the letter was presented varied randomly from pair to pair. Neufeldt observed that when the retarded subjects were instructed to report the items of one type and then the items of the other type, recall was more successful. The normal subjects, however, appeared to be equally proficient in recall regardless of the strategy they employed. Neufeldt concluded that, though normals could tolerate each type of recall strategy equally well, retardates had more difficulty recalling the information by sides of the head than by types of stimuli.

In statistical analyses of the above mentioned experiments, Neufeldt found that subjects of organic retardation did consistently poorer in all the experiments than did those subjects of cultural familial background (experiment #1, $p < .05$; experiment #2, $p < .05$; experiment #3, $p < .001$). Additionally, the cultural-familial subjects did consistently poorer in all the experiments than did the normal mental age group (experiment #1, $p < .01$; experiment #2, $p < .001$; experiment #3, $p < .01$), while the performance of the normal chronological age control group was consistently superior (experiment #1, $p < .01$; experiment #2, $p < .001$; experiment #3, $p < .01$) to all the groups tested.

Why this difference between the four groups? Neufeldt hypothesized that perception and assimilation of information is a process and product not only of intelligence, but also of maturity, as evidenced by the consistently better performance of the normal chronological age control group. Perhaps this group has had more practice and experience in encoding information and adjusting encoding strategies to facilitate assimilation of material.

Neufeldt interpreted and reported the results of his experiments by noting ear order in the perception and sequencing of material, rather than ear-effect, and apparently, there have been no investigations to determine whether or not an ear-effect does exist in a retarded population.

Feldmann (1960) utilized a dichotic test as a determinant of hearing acuity. He noted that patients who failed the test frequently commented that the words on one side faded out so rapidly from their memory that they could not grasp them, even though they were noticed acoustically. This observation would seem to lend additional support to Neufeldt's hypothesis of short-term-memory decay. Kimura (1961) offers a plausible explanation and hypothesis of short-term-memory decay when she speculates that differences in the auditory pathways could provide a basis for reporting the right channel first, i.e., the subject may select the neurologically stronger of the two channels with which to begin reporting.

CHAPTER II

STATEMENT OF THE PROBLEM

As stated in the previous chapter, most of the experimental observations and theoretical explanations concerning the relationship of cerebral dominance to the ear effect in dichotic listening have been based on studies with normal or brain-damaged adults in whom cerebral dominance had already become established.

Neufeldt's experiments in 1966 with retarded subjects provide the only available report of a dichotic listening task as applied to retarded children, although Kimura used the phenomenon to investigate the age levels at which cerebral dominance becomes established in normal children.

In order to further clarify the question of the ability of retarded children to respond to a dichotic task, a preliminary investigation was conducted with a group of ten retarded children. The chronological ages of these children ranged from 8-10 to 13-9, with a mental age range of 4-6 to 9-10. Seven of the group responded to 75% or more of the 20 trials in the test, thus lending evidence to the speculation that the dichotic task might be a suitable test for investigating cerebral dominance and speech lateralization in retardates.

The present study, then, utilized the dichotic listening task to assess cerebral dominance and speech lateralization in retardates. The research questions investigated were:

(1) What differences can be demonstrated between the mental age at which the ear-effect appears in a retarded population to the mental-chronological age at which it appears in a normal population?

(2) What relationships can be demonstrated between development of the ear-effect and development of speech and language in a retarded population?

(3) What differences can be demonstrated between retarded girls and boys in the development of cerebral dominance?

(4) What differences can be demonstrated between the performances of those children with etiologies of organic retardation, and those children with etiologies or backgrounds of cultural-familial retardation?

CHAPTER III

METHODS AND PROCEDURES

This chapter will deal with the selection of subjects, test instrumentation, and procedures for gathering and analyzing the data.

Subjects

The subjects were randomly selected from the Enid State School for the Mentally Retarded, Department of Institutions, Social and Rehabilitative Services of the State of Oklahoma, at Enid, Oklahoma. All subjects possessed the following characteristics:

(a) Subjects were residents of the Enid State School.

(b) Subjects' chronological age was between 6-0 and 18-0, and mental age was between 4-0 and 9-0. These ranges were selected to correspond roughly to the mental-chronological ages of the normal children tested by Kimura. *The Peabody Picture Vocabulary Test, Form B*, was used as an index of mental age of the retarded subjects due to its ease of administration and scoring, and high correlation with more established tests of intelligence such as the *Stanford-Binet* and the

Wechsler Intelligence Scale for Children. Although no attempt was made to match males and females by chronological and mental age, the mean mental age for the males was 6-3, and 6-4 for the females. The mean chronological age for males was 14-8, and 14-4 for the females.

(c) Subjects demonstrated intelligible expressive speech. Each subject was asked to repeat digits from 0 through 9, since those digits comprised the only expressive speech necessary in the task. Those subjects who evidenced questionable intelligibility were dismissed from the study.

(d) Subjects responded to 75% or more of the 20 test trials. This reduced the possibility of evidencing an ear-effect merely by chance.

A total of 61 children were tested and 44 met the test criterion. Of these 44, 22 were males, and 22 were females.

Tape Preparation

The dichotic test tape consisted of 20 trials, each trial consisting of three pairs of randomly selected digits (6 digits total), presented synchronously, one-half second apart, with one digit of the pair presented to one ear and the other digit presented to the opposite ear. The tape was recorded using two dual channel tape recorders (Ampex AG500 and Sony 777) and a cueing device, according to the system developed by Carr and Dovala (1969). The listener, then, heard different digits simultaneously in each ear. As an example, one trial set might present the digits 018 in the right ear and the digits 296 simultaneously in the left ear. There was a ten second pause between trials so that the subject could respond by repeating the digits which he heard. Each trial was preceded by an identifying number, i.e. "Trial 1.....Trial 2.....Trial 3.....Trial 20."

Instrumentation

Each subject was seated in a sound treated room (IAC 1600A). Pre-recorded instructions presented through headphones (Telephonics TDH-39) explained that different digits would be heard simultaneously in each ear and that all numbers heard in both ears were to be repeated (see Instructions to Subjects, Appendix A). The instructions included three practice trials for purposes of clarification and familiarization with the task. Following the instructions the test materials were presented at a comfortable loudness level (65-70 dB, as measured by a Realistic Music/Sound Level Meter, #33-1028, taken at a fast reading), through a Sony 650 dual-channel tape recorder. The loudness balance of each channel was adjusted when necessary to maintain equal loudness levels between ears for each subject. In order to compensate for slight differences inherent in the tape channels, 22 of the subjects (11 males, 11 females) received channel A materials in the right ear and channel B materials in the left ear, with the procedure reversed for the remaining 22 subjects.

The subjects' responses were recorded on another tape recorder, and on a special data sheet devised for this purpose (see Response Record Form, Appendix B). This procedure allowed the experimenter to double check his recorded responses, and it facilitated independent reliability checks (subsequent independent reliability check revealed 100% reliability of recorded responses).

CHAPTER IV

RESULTS

This chapter is concerned with presentation of the data derived from this study. The dichotic listening task was administered to 61 subjects, although failure to meet one or more of the study criterion reduced the final number to 44, 22 males, and 22 females. Scores for the dichotic listening task were recorded and statistical procedures were employed to test for differences between groups. Comparisons were also made between the dichotic listening data and scores of the subjects on the *Peabody Picture Vocabulary Test, Form B*.

In the initial part of the analysis, "t"-tests on dichotic listening scores were computed between the following groups:

(1) mean score of right-ear responses and mean score of left-ear responses for males.

(2) mean score of right-ear responses and mean score of left-ear responses for females.

(3) mean score of right-ear responses and mean score of left-ear responses of subjects with etiologies indicating cultural-familial background.

(4) mean score of right-ear responses and mean score of left-ear responses of subjects with etiologies of organic retardation.

Table 1 indicates the results of the "t"-tests applied to the data. Although no statistical significance was achieved among the various groups, there appeared to be a tendency for the right ear to be superior to the left ear. Total right ear scores were higher than total left ear scores, for both males and females, with males achieving higher total scores than females for both ears. Even though statistical significance was not achieved between group means, several individuals in the various groups did evidence significant ear-effects for both right-ear and left-ear. This evidence of lateralization seemed to be independent of mental age and chronological age, as subjects with mental ages as low as 4-4 were as capable of responding as subjects with mental ages as high as 8-9. Handedness did not seem to be an influencing factor either, as subjects who evidenced a strong ear-effect often habitually used the hand of the contralateral side.

Correlations (Pearson r) were also calculated between boys' mental age levels and their dominance index, and between girls' mental age levels and their dominance index. Dominance index is here defined as being the difference in raw score between the two ears. Unexpectedly, the boys evidenced a significant correlation (at the .02 level of confidence), but the girls did not, even though both groups were matched in terms of mental age and chronological age. It would appear from the raw data then, that as mental age increases the dominance index moves in the direction of a positive correlation, although the effect was not statistically significant for the female subjects in this study.

TABLE I

MEAN NUMBER OF DIGITS CORRECTLY REPORTED FOR EACH GROUP

Group	N	Mean	t
Boys right ear	22	28.0	.120
Boys left ear	22	27.5	(42 df)
Girls right ear	22	27.5	1.300
Girls left ear	22	22.0	(42 df)
Familial right ear	13	25.84	.143
Familial left ear	13	25.15	(24 df)
Organic right ear	18	27.11	.106
Organic left ear	18	26.50	(34 df)
Familial right ear & left ear	26	25.5	.590
Organic right ear & left ear	36	26.8	(60 df)

CHAPTER V

DISCUSSION AND CONCLUSIONS

Restatement of the Problem

This investigation was primarily concerned with the following questions:

(1) Is there a significant relationship between the mental age at which the ear-effect appears in a retarded population and the mental-chronological age at which it appears in a normal population? Since Kimura (1963) found a right-ear superiority in most normal children at four years of age, one could hypothesize that a retarded population will evidence this ear-effect at a mental age comparable to the mental-chronological age of normals.

(2) Is there a significant relationship between development of the ear-effect and development of speech and language? Perhaps those retarded children who develop speech and language to the greatest extent are the same children who exhibit a significant ear-effect. Whether the child's level of proficiency in language skills, as suggested by performance on the _Peabody Picture Vocabulary Test, Form B_, is a function of maturity, as Neufeldt (1966) suggested, or a function of intelligence, will be discussed below.

(3) Do significant differences exist between retarded

girls and boys in the development of cerebral dominance? Do girls demonstrate or evidence a superiority over boys in this development? As stated previously, Kimura (1963) found that the left hemisphere is dominant for speech by age four, for both sexes, but that boys, in terms of raw data, lagged behind girls in this development.

(4) Can significant differences be demonstrated between the performances of those children with etiologies of organic retardation, and those children with etiologies or backgrounds of cultural-familial retardation? As mentioned in the first chapter, Neufeldt (1966) found in his experiments that children with backgrounds of cultural-familial retardation were consistently superior in response to the dichotic task, compared to those children with etiologies of organic brain damage. Assuming that such a difference could indeed be established, the dichotic task might prove to be a valuable clinical tool in the diagnosis and evaluation of retarded subjects.

Discussion of Results

Although statistical significance was not achieved among the various groups tested, there did appear to be a tendency for the right ear to be superior to the left ear. This tendency towards lateralization seemed to be independent of mental age and chronological age. It was noted that subjects with mental ages as low as 4-4 were quite capable of responding, and other subjects with mental ages as high as 8-9 were noticeably poorer in their responses. It was further noted that many of the subjects tested tended frequently to report only two or three digits of the six digit series. The two or three digits reported tended also to be of one side or the other, with minimal intercourse of the two sides. In other words, if the subject heard 018 in the left ear and 296 in the right ear, he would frequently respond by recalling only those digits heard in one of the ears, and would fail to recall those digits heard in the opposite ear. Specifically, of a possible total of 880 test trials, 428 of the trials recalled were of one side only. Recall was equal between the ears on 137 trials, while the remaining 315 favored one ear over the other, although not to the exclusion of the opposite ear. This would lend some support to the hypothesis proposed by Broadbent (1958) and cited by Neufeldt (1966), of sensory channels that play a decisive role in the perception and sequencing of information arriving at the two ears. If failure to report all six digits presented in one trial is due, as Neufeldt suggests, to decay of the memory traces of the short-term-memory system, one would expect those subjects with higher mental ages to perform significantly better in response to the trials than those subjects with lower mental ages, due to their maturity and sophistication with encoding information in a learning process. It was also noticed that handedness did not seem to be an influencing factor, as subjects who evidenced strong ear-effect on one side often used the hand of the contralateral side. Kimura's 1961 study with brain-damaged adults confirmed that handedness was not a factor in determining hemispherical dominance, and the results of this experiment add support to that observation.

Correlations (Pearson r) were also calculated between boys' mental age levels and their dominance index (the difference in raw score between the two ears), and between girls' mental age levels and their dominance index. Although the boys evidenced a significant correlation at the .02 level of confidence, and the girls did not, it would appear from the raw data, that as mental age increases, the dominance index tends to be positively correlated. One explanation for this difference in correlation might be found in the somewhat greater variance in the girls scores than in the boys scores. The boys scores approximated a rather linear correlation, while the girls scores tended to be much less linear. Perhaps if a greater N were tested, with more precise controls over such variables as mental age, chronological age, etiology of retardation, and sex, a positive correlation might be established for both sexes. Such a finding would provide the diagnostician and clinician with a valuable tool in evaluating a child's performance and abilities in the development and function of speech and language. For instance, as a child's mental age level approached his chronological age level, one could speculate as to the degree of lateralization of speech and language functioning, and be relatively well-assured of an accurate speculation. Or perhaps a correlation could be found between The Peabody Picture Vocabulary Test and the dichotic listening task. Such a correlation would allow the examiner or clinician to make relatively accurate speculations about the establishment and development of cerebral dominance on the basis of the mental age score the subject achieves on the Peabody. The reverse might also be true; a relatively accurate determination of mental age based on the results of a dichotic listening task.

In addition to this difference in mental age level and dominance index between boys and girls is the fact that boys achieved higher total scores than girls for both ears. This would appear to be at variance with the results obtained by Kimura in her 1963 study with normal children. She reported that girls had higher total right ear scores than did boys, but that neither of the two groups achieved statistical significance. Perhaps one explanation for the difference in scores between the two groups in the present study can be found in the greater variance of the girls' scores. The boys' scores approached a much more linear correlation, tending to be grouped together much more closely than did the girls' scores. This grouping of the boys' scores would result in a consistent increase in the total score, rather than the sporadic increase evident in the girls' total scores.

Although no significant difference was obtained between the performance of children diagnosed as organically retarded and those diagnosed as retarded due to a cultural-familial background, the former group tended to do slightly better in their responses to the dichotic task, in that they evidenced slightly higher total scores than did the cultural-familial group (see table on page 18). Neufeldt (1966) reported that those subjects with etiologies of cultural-familial retardation performed consistently better on all the experiments than did the subjects with some type of organic retardation. Perhaps more extensive testing would bear out and corroborate Neufeldt's findings. The present study did not.

Conclusion and Implications for Further Investigation

Perhaps the most obvious fact observed in this study is that this retarded population did not exhibit a statistically significant cerebral dominance for speech, as measured by the dichotic task. There was no significant group ear effect, either right or left, and neither mental age nor chronological age seems to be an accurate predictor of performance on the dichotic task (in terms of ear effect and overall accuracy of response). This study has neither lent support to, nor refuted, Kimura's hypothesis that the left cerebral hemisphere has an early prepotence for speech and language dominance. This lack of demonstrable right-ear effect would seem to suggest that variables other than the ones controlled in this investigation play an important role in the establishment of cerebral dominance for purposes of speech and language functioning. These variables may include such factors as the sensory modality through which an individual may perceive and learn most readily, or the factors which affect sequencing and encoding of information. If investigators can discover these variables, and control them effectively, it could provide us with valuable information as to how the human organism perceives, processes, and transmits symbolic stimuli. If, on the other hand, it could be demonstrated that this retarded population failed to demonstrate an ear effect, right or left, because dominance had not yet developed, therapists and clinicians would be alerted to the level of the child's most crucial speech and language need.

Although there was a tendency for right ear dominance, the lack of a significant ear effect could indicate that cerebral-dominance, or the lack thereof, is a significant factor in the condition of retardation. It certainly would not be the only factor, since some individuals of normal intelligence also fail to exhibit an ear effect. Nevertheless, the question would seem to merit further study. If the lack of cerebral dominance does contribute to retardation, therapy techniques for encouraging dominance should be appropriate for a retarded population. This could be tested by applying such therapy procedures with a selected group and monitering intellectual functions.

Areas for future investigation might center around more complete study of performances of children with etiologies of cultural-familial retardation and children with etiologies of organic retardation. If a significant difference can be determined between these two groups, this difference could be regarded as another clinical tool in the diagnosis and prognosis of speech and language functioning.

Another suggested area for future investigation concerns the work of Katz (1969) and others in developing reliable localization tests. The use of central auditory tests (tests which assess the primary auditory reception centers of the brain) is increasing in the field of audiology and audiometry. The need for methods and standards to assess cerebral integrity are presently more critical than measures of cochlear or retrocochlear function (Katz, 1969). If the dichotic task can be standardized to a retarded population, then one could speculate that those subjects who demonstrate bizarre or deviant responses to the dichotic task may be evidencing temporal lesions, VIIIth nerve damage, or possibly auditory-perceptual disturbance. For instance, if the question of hearing loss can be ruled out, then one could proceed to test for temporal lobe lesions in a manner similar to that investigated by Bocca and others (1954). They determined that patients with temporal lobe lesions evidenced a deterioration in performance on a dichotic task, in the ear contralateral to the damaged hemisphere (even though the stimuli were presented at optimal intensity level), when the high-frequency components were reduced or eliminated by a 500 Hz low-pass filter. Their patients were unable to recall and repeat the stimuli correctly when filtered but gave accurate responses in the unfiltered condition. If results such as these were found to be consistent from subject to subject, then such an observation should prove to be beneficial to the audiologist in differential diagnosis of auditory disorders. Further investigation of responses at varying frequencies may result in the development of reliable localization tests or predictors of central auditory dysfunction. Since present localization tests are ill-defined as to what they are measuring they are of dubious value, thus, the need for a reliable and valid index of central auditory processes.

In conclusion, this study was conducted to investigate only a few of the many problems of the retarded. Perhaps with a more extensive investigation the dichotic task will uncover characteristics of the retarded which will provide clinicians with valuable diagnostic and prognostic information.

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APPENDIX A

INSTRUCTIONS TO SUBJECTS

The following instructions were tape recorded and played to all Ss.

Let's play a game. I'm going to say some numbers. I want you to say as many of the numbers back to me as you can. But I'm going to mix the numbers up. You'll hear some numbers in this ear (right).....and then some different numbers in this ear (left). Remember, I want you to listen very hard to what numbers I say, and then you say the same numbers back to me. If you can hear me louder in one ear than in the other, raise your hand right now. O.K., let's practice.

Ready.....here we go.....listen very hard.....(Practice trial).....(Practice trial).....(Practice trial).....

O.K., that was pretty good. Don't worry if you can't say all the numbers. Just say as many as you can remember.

Now let's play the game.....listen very, very hard and say as many of the numbers as you can.

Ready.....here we go.....(Trial 1).....(Trial 2).....etc.

O.K., we're all finished. You can take off the headphones. You did a very good job.....thanks for playing.

APPENDIX B

RESPONSE RECORD FORM

NAME______________________________M.A.______________________________
SEX_______________________________DATE______________________________
C.A.______________________________COTTAGE___________________________
ETIOLOGY OF RETARDATION
____

****

EAR______		EAR______	NO. CORRECT LEFT	RIGHT
1.	194	083	________	________
2.	120	479	________	________
3.	024	479	________	________
4.	319	782	________	________
5.	907	816	________	________
6.	049	631	________	________
7.	340	871	________	________
8.	319	476	________	________
9.	941	820	________	________
10.	183	962	________	________
11.	089	140	________	________
12.	817	536	________	________
13.	193	002	________	________
14.	182	497	________	________
15.	943	167	________	________
16.	490	856	________	________
17.	201	658	________	________
18.	903	714	________	________
19.	134	067	________	________
20.	012	897	________	________

VITA

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Candidate for the Degree of

Master of Arts

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