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A Comparison of Language Delayed and Non-Language Delayed Children on a Dichotic CV Syllable Listening Task

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This thesis, directed and approved by the candidate's committee, has been accepted by the Graduate Committee of The University of New Mexico in partial fulfillment of the requirements for the degree of

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Title A COMPARISON OF LANGUAGE DELAYED AND NON-LANGUAGE DELAYED CHILDREN ON A DICHOTIC CV SYLLABLE LISTENING TASK

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THESIS

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ABSTRACT OF THESIS

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The University of New Mexico, 1975

Numerous investigations have reported that normal listeners show a right ear preference for dichotically presented speech stimuli. This preference depends on the fact that the left hemisphere is dominant for speech. Performances of non-language delayed children tend to reveal the expected right-ear advantage, even though inter-subject variability is observed.

Language delayed subjects exhibit rather unpredictable performances ranging from a lack of ear preference to a left-ear advantage. The primary purpose of this investigation was to compare the performance of a group of language delayed children with a group of non-language delayed children, on a dichotic CV syllable listening task. The reliability of the dichotic task on test-retest conditions for both groups, and the performance differences of male and female subjects in the non-language delayed group were also examined.

Comparisons made on absolute values between the non-language delayed and language delayed subjects revealed no significant differences. Within group comparisons, however, revealed a significant right-ear advantage for non-language delayed subjects on test and retest conditions. Language delayed

subjects showed a lack of ear preference for the test condition and a significant right-ear advantage for the retest condition. No significant differences were found between male and female performances in the non-language delayed group, however, females had a tendency to report greater left-ear correct scores on the retest conditions than males. Furthermore, no relationship was found between test and retest performances for language delayed or non-language delayed subjects. The lack of reliability observed in this investigation suggests that any similarities or differences reported between the language delayed and non-language delayed subjects in comparison to other investigations, may be the result of a chance occurrence.

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CHAPTER I

REVIEW OF THE LITERATURE, SUMMARY, AND STATEMENT OF THE PROBLEM

Review of the Literature

Over a century of study has been devoted to investigations concerned with the relationship of cerebral dominance to either the right or left hemispheres, specifically concerning the functions of speech and language. Important inferences about lateralization of speech and language have resulted from these studies.

The first proponent of speech lateralization was Marc Dax, who in 1811 stated the possibility of a relationship between speech and its localization in the left hemisphere (Goodglass and Quadfasel, 1954). In 1861, Broca began through medical investigations, the study of speech loss due to brain damage. From his findings, he reported that damage to the third frontal gyrus of the left hemisphere, now referred to as Broca's area, resulted in a deficit in expressive speech. A description of language disorders resulting from damage to an area between Heschl's gyrus and the angular gyrus was reported in 1874 by Wernicke (Geschwind, 1972).

The investigations of Broca and Wernicke marked the beginning of experimental studies designed to explore the functions of the right and left cerebral hemispheres. In

1959, Penfield and Roberts used direct electrical stimulation of the cerebrum to identify specific areas involved in speech. Through their method of direct stimulation three speech areas were defined. Stimulation of these three resulted in speech interference. From the results of their investigations, Penfield and Roberts concluded that the left hemisphere was usually dominant for speech. The investigation of Wada and Rasmussen in 1960 produced another method of interpreting speech processing in the brain by injecting sodium amytal into the right or left carotid artery. Injections directed toward the dominant hemisphere resulted in contralateral hemiparesis with deterioration of speech, while injections toward the non-dominant hemisphere showed no effect on speech. Branch, Milner, and Rasmussen (1964) reported this method to be highly accurate in predicting the dominant speech hemisphere.

Dichotic listening tasks, the presentation of different auditory stimuli simultaneously to both ears, were first introduced by Broadbent in 1954 during experiments with auditory memory span. It was Kimura (1961b) who began the first study using dichotic listening tasks in determining cerebral dominance for speech. Through the presentation of pairs of dichotic digits, Kimura found that stimuli directed to the right ear were more accurately perceived than stimuli directed to the left ear. Her findings of a right ear advantage, plus the accepted belief of a dominant left hemisphere for speech, suggest that the contralateral pathways between the ear and the auditory cortex are stronger than the ipsilateral pathways (Kimura, 1961a). Noback and Demarest (1972) further supported Kimura's findings by reporting anatomical evidence that most cochlear nerve fibers decussate in the brain stem.

Since Kimura's investigations in 1961, dichotic listening tasks have been used extensively in the study of cerebral dominance. In a review by Shanks (1973) the following investigations employing dichotic listening were summarized:

1. Dichotic stimulation reveals a right ear advantage for speech stimuli, which reflects processing in the left hemisphere, and a left ear advantage for non-speech stimuli, which reflects processing in the right hemisphere.

2. Lateralization on dichotic tasks has been discovered by the age of five, with females establishing cerebral dominance slightly earlier than males.

3. No direct relationship has yet been found between handedness and hemispheric dominance for speech, however, reversals are reported more frequently among left-handed subjects.

4. Right ear superiority is retained even when order of report is controlled, therefore the asymmetry found on dichotic listening tasks is not due to greater trace decay of the stored stimuli or to attentional bias.

5. When the dichotic stimuli presented to the right

ear is 10 dB less intense than the stimuli presented to the left ear, the right ear superiority is still upheld.

6. The left ear overcame the right ear when a lag time of 30-60 msec was presented, but both stimuli were perceived accurately with lag time greater than 250 msec.

7. On dichotic listening tasks, the right-left difference was maximized when the stimuli were presented at 50 dB SPL, and when onsets of the stimuli were precisely aligned.

In 1974, Goldstein and Lackner offered a further suggestion for the right ear advantage other than contralateral auditory pathways as suggested by Kimura (1961a). They revealed that a subject's perceived spatial orientation may effect laterality. In a dichotic study using consonant-vowel (CV) syllables as stimuli, they found that the typical right ear advantage was reduced if subjects wore prisms that displaced their visual environments to the left. An increased right ear advantage was noted when prisms displaced the environment to the right. This study implies that lateralization depended to some degree on the spatial origins of the signals.

Dichotic Listening in Normal Children

Investigations involving dichotic listening tasks with adults are numerous, however, little research has been conducted in regard to dichotic listening in children. In a study by Kimura (1963) 145 normal children between the ages of four and nine were tested with dichotically paired digits. The results of her investigation revealed a right ear effect for boys and girls as early as age four. At the early ages, boys achieved lower scores than girls. From these findings it is suggested that the left hemisphere is dominant for speech by the age of four for both boys and girls, but the boys were found to lag behind the girls in the development of speech perception and speech sounds. This difference was found to disappear at age seven. In 1970, Nagafuchi investigated the development of monaural hearing abilities in children. In this study 80 normal children from three to six years and five young adults participated. Paired spoken words were presented first with different words arriving simultaneously at the two ears and then at one ear. The results of the test revealed a right ear superiority. In the monaural presentation the results were almost identical for each ear. The six year old children and the young adults shared almost identical results. The three year old girls were found to be superior to boys on both dichotic and separation abilities, but no difference was found between girls and boys in the older age groups.

One type of dichotic stimuli used frequently with adults is the presentation of nonsense consonant-vowel (CV) syllables. This type of stimuli was used by Berlin et al., in 1973, in a study of dichotic effects in children from ages five to 13. In this study it was found that a right ear effect was fixed by age five. The results of the 11-13 year olds were similar to results found in young adults. In an analysis of single correct responses, the right ear advantage was not found to vary significantly with age. The number of double correct responses did appear to increase as a function of age.

Dichotic listening performance was investigated by Bryden (1970) in 234 children in grades two, four, and six. Dichotic stimuli included digit pairs and three pairs of digits. At the sixth grade level, a significant difference was found between right and left handers in regard to ear superiority and increasing age. A right ear superiority increased with age in the right-handers and decreased with age in the left-handers. This study also investigated the relationship between laterality effects and reading ability. Crossed ear-hand dominance was more likely to be found in boys who were poor readers than in boys who were good readers. This effect was evident in girls only at the second grade level.

Dichotic Listening and Communicative Disordered Children

The performance of individuals with cleft palate on a dichotic listening task has been investigated by Ryan et al., (1974). Information was collected on 14 males and 16 females ranging in age from six to 19. CV syllables were presented as dichotic stimuli. The results of the investigation revealed that the cleft palate sample tested performed in a similar manner to normal individuals on dichotic listening tasks. However, the cleft palate subjects were differentiated from the non-cleft listeners on an age basis, and by the lack of a clear cut right ear superiority for the dichotic material presented. There was also a reported reduction in the ability of cleft palate individuals to identify two simultaneous stimuli correctly. The authors tentatively concluded that "the dichotic performance of our cleft group reflect the mild, but nevertheless significant, diminution of language performance in the cleft lip and palate population," (p. 4). They further stressed the fact that other factors often found in the cleft palate population such as early hearing loss, prolonged hospitalization, possible neurological deficits, and lower socioeconomic class may all interact to influence the language and dichotic listening performance of the population.

The child with a language disorder has been labeled and classified in many ways, from the delayed language child to the child with minimal brain dysfunction. Environmental deprivation, neurological impairment, emotional disturbance, and hearing loss are among factors which may contribute to or result in a language disorder. Little dichotic research has been conducted on the child with a language disorder.

In 1971, Helms conducted an investigation comparing dichotic listening performance among language disordered children, articulation disordered children, and children with normally developing speech and language. The Dichotic Digits Test and the Dichotic Animal Names Test were used as test stimuli. The results of the study revealed an unpatterned ear preference for the language delayed children, suggesting unlateralized cerebral dominance for speech. The articulation disordered children and the normal children showed comparable right ear preference for the dichotic stimuli.

In a study by Sommers and Taylor (1972) the performance of 10, five and six year old children with histories of language delay, and 10 normal children was compared on dichotic listening tasks. Forty phonetically similar word-pairs were used as stimuli. All 10 subjects in the control group showed a right year preference. The language delayed children were less effective in the recall of dichotic stimuli and showed a larger amount of variability in ear choice than the normal group.

It has been speculated that children with auditory-linguistic deficits may have atypical speech lateralization. Witelson and Rabinovitch (1972) hypothesized that these children differ either in degree of or laterality of hemispheric speech lateralization compared to normal children. A left ear superiority was found in the learning-impaired group. The authors suggested that these children did have a definite laterality of speech functions. The incidence of left ear superiority is higher in this group than what is expected in the normal population.

In 1971, Geffner and Hochberg conducted a study comparing the ear laterality performance of children four to seven years from low and middle socioeconomic levels on a dichotic digit task. Thirteen girls and 13 boys of each socioeconomic level were placed in each age group from four to seven. Right ear superiority was shown by the four, six, and seven year olds from the middle socioeconomic level, and by the seven year olds from the low socioeconomic level. Children from the lower level demonstrated the right ear effect at a later age and to a lesser degree than did the middle class children. There was no significant difference reported between the sexes on the test.

In a study involving 32 educable retarded children using dichotically presented one syllable words, Jones and Spreen (1967) reported that words presented to the right ear were significantly better recalled than were words presented to the left ear.

Ling (1971) used ear asymmetry for dichotic digits in an attempt to estimate speech laterality in hearing impaired children. Nineteen normal and 19 hearing impaired children served as subjects. The hearing impaired group rarely reported both members of a dichotic pair. One digit apparently masked or suppressed the other. The author concluded that speech laterality could not be safely inferred from the results of dichotic scores of hearing impaired children.

Dichotic Listening and Reliability

A scant amount of research has been designed to assess listener reliability on dichotic listening tasks. Ryan and McNeil (1974) conducted an investigation using competing CV syllables. Results of the investigation indicated that a right ear effect is reasonably stable, suggesting a high degree of listener reliability on dichotic listening tasks. However, in a recent Master's Thesis by Johnson (1974) test-retest performance was found to be related but it varied according to subjects' sex and the measure used to indicate ear preference. Significant differences were also found in dichotic performance between males and females.

Summary

Dichotic listening investigations using digit pairs, nonsense CV syllables and word pairs have been conducted extensively with normal adults. Several dichotic studies employing similar stimuli have been conducted with normal children. The results of these studies revealed a right ear advantage for dichotically presented speech stimuli, as early as age five. In the relatively few dichotic studies of language disordered children, dichotic stimuli employed in these investigations typically using digits, word pairs and animal names, language delayed children showed a greater amount of variability in ear choice as compared to normal children. Dichotic listening using CV syllables has not been conducted on language delayed children. Performance by language delayed children on a dichotic listening task employing nonsense CV syllables was the primary area of interest for this study.

Due to the limited availability of information on test-retest reliability of verbal dichotic listening tasks and the interesting findings by Johnson (1974) of a difference in performance on dichotic tasks between males and females, this study also assessed the stability of listener performance for both the normal and language delayed children, and sex-related differences for the normal group.

Statement of the Problem

The main objective of this study was to investigate the dichotic listening performance of language delayed children as compared to normal children. Listener reliability on dichotic stimuli was also studied.

The investigation was directed toward answering the following specific questions:

1. How does the performance of language delayed children on a dichotic CV syllable listening task compare to that of normal children?

2. How does the performance of males and females differ in regard to accuracy of response or magnitude of ear

superiority?

3. What relationship is found between test-retest conditions on measures of dichotic listening performance?

CHAPTER II

PROCEDURE

Subjects

Nineteen children, nine language delayed and 10 non-language delayed, from the ages of five through ten served as subjects in the present study. The language delayed group consisted of three females and six males with a mean age of seven years, four months. Eight of the nine subjects were right-handed, one was left-handed. Language delayed subjects were selected from a group of children diagnosed as such by speech clinicians from the University of New Mexico Speech and Hearing Center, the Rehabilitation Center Incorporated of Albuquerque, and upon meeting the following criteria:

1. Each subject demonstrated normal intelligence as defined by a score of 100± 12 and above through administration of the Columbia Mental Maturity Scale (1974). The Columbia measures a child's general reasoning ability.

2. Each subject demonstrated a Scaled Score mean of below 30 on the following subtests of the Illinois Test of Psycholinguistic Abilities (ITPA):

a. Auditory Association: The ability to relate orally presented concepts is measured in this subtest.

b. Visual Association: This subtest measures the child's ability to relate concepts presented visually.

c. Auditory Sequential Memory: A child's ability to reproduce from memory digit sequences of increasing length from two to eight digits is measured in this subtest.

d. Grammatic Closure: This subtest evaluates the child's ability to make use of the redundancies of oral language in the acquisition of automatic habits for handling syntax and grammatic inflections.

3. Auditory discrimination within normal limits was achieved, as demonstrated by the correct identification of six recorded CV syllables presented monaurally to each ear at 75 dB SPL.

4. Each subject was a native speaker of English.

5. No history of brain pathology was reported.

6. Each subject demonstrated hearing sensitivity within normal limits: pure tone thresholds no worse than 20 dB HTL at any frequency from 250-4000 Hz.

7. Each subject demonstrated symmetrical hearing: not more than 10 dB difference between ears at any frequency from 250-4000 Hz.

The non-language delayed group consisted of five females and five males with a mean age of seven years, one month. All non-language delayed subjects were right-handed. Non-language delayed subjects were chosen from a group of professors' children at the University of New Mexico, from families of speech clinicians at the University of New Mexico Speech and Hearing Center, and upon meeting the following criteria:

1. Each subject demonstrated normal intelligence as defined by a score of 100± 12 and above through administration of the Columbia Mental Maturity Scale (1972).

2. Each subject demonstrated a Scaled Score mean of 30 and above on the four previously mentioned subtests of the ITPA (1968).

3. No history of brain pathology was reported.

4. Auditory discrimination within normal limits was achieved, as demonstrated by the correct identification of six recorded CV syllables presented monaurally to each ear at 75 dB SPL.

5. Each subject was a native speaker of English.

6. Each subject demonstrated hearing sensitivity within normal limits: pure tone thresholds no worse than 20 dB HTL at any frequency from 250-4000 Hz.

7. Each subject demonstrated symmetrical hearing: not more than 10 dB difference between ears at any frequency from 250-4000 Hz.

Stimuli

The test stimuli consisted of 30 pairs of natural speech CV syllables, representing all possible combinations of /pa, ta, ka, ba, da, ga/. Two different CV syllables were presented simultaneously, one going to each ear, for each of the 30 test items. Kresge Hearing Research Lab of the South developed a two-channel tape whereby each dichotic pair is precisely aligned (±2 msec) at syllable onset. Each dichotic pair is separated by a six-second time interval. Due to the complexity of the task, the tape was controlled manually to allow subjects enough time to respond between dichotic pairs.

Calibration at the earphones was facilitated by a 1000 Hz tone at the beginning of the tape. The following instructions preceded the dichotic stimuli, on order to verify that each channel was directed to the intended ear: "This is Channel I, point to the ear in which you hear me: this is Channel II, point to the ear in which you hear me."

Instrumentation and Calibration

A Grason-Stadler 1701 audiometer was used to obtain pure tone air conduction thresholds. Only one earphone of matched TDH-39 earphones mounted in MX41/AR cushions was used, to control for possible instrumentation bias.

A Bruel and Kjaer artificial ear, Type 4152, coupled to a Bruel and Kjaer sound level meter, Type 2204 was used to calibrate the apparatus at each earphone, prior to presentation of the dichotic stimuli. At the beginning of the tape a 1000 Hz calibration tone was peaked at zero on the VU meter of the audiometer, with necessary adjustments made at the attenuators to equate the output intensity (75 dB SPL) of the two channels of the playback system.

The subjects were presented a 12-item discrimination test and the 60-item dichotic listening test from a

Sony TC-366, two-channel tape recorder. One monosyllable of each competing pair was delivered through Channel I, and the other through Channel II of the audiometer. Each channel was connected to one of the two acoustically balanced earphones. All testing was carried out in a double-walled IAC booth.

Test Procedure

A subject information form, shown in Appendix A, was completed by the parents of each child before the administration of a pure tone threshold test. Following pure tone audiometry, each subject listened to a discrimination test consisting of 12 monosyllables. The syllables were presented monaurally, six to each ear. The subjects pointed to their answers on a large response card containing the six CV syllables, while the tester recorded the responses. The instructions for the dichotic test were then explained to each subject, as shown in Appendix B. All subjects were allowed as much time as necessary to respond to each dichotic presentation. The subjects were told that they must respond with two different answers for each pair, even though they may have heard only one syllable. All responses were recorded on an answer sheet, as shown in Appendix C. Thirty dichotic test items were presented, with Channel I of the tape being delivered to the right ear, and Channel II to the left ear. The earphones were then reversed and the tape repeated.

To control for the possibility of instrumentation bias and order effects, a counterbalancing paradigm consisting of eight conditions was followed (Appendix D). Subject 1 was tested in accordance with Condition 1, Subject 2, in accordance with Condition 2, and so on.

Approximately two weeks to one month after initial testing, depending on transportation availability, each subject returned to be tested with the same dichotic stimuli.

Data Reduction and Analysis

Raw scores tabulated for each subject on the dichotic task were converted in the following manner:

1. Total Right Ear Correct
2. Total Left Ear Correct
3. Total Single Correct - Right Ear
4. Total Single Correct - Left Ear
5. R-L Difference Score - Left ear score substracted from right ear score.
6. POC Score (Percent of Correct) - Right ear correct divided by total correct: $\frac{R}{R + L} \times 100$
7. POE (Percent of Error) - Left ear errors divided by total errors: $\frac{\text{L errors}}{\text{L+R errors}} \times 100$

Measures of central tendency and variability were then made and the data obtained submitted to analysis by a t-test to evaluate mean differences. The Pearson product-moment correlation coefficient was used to examine test - retest reliability.

CHAPTER III

RESULTS AND DISCUSSION

Results

The results of this investigation will be presented in the following order: comparisons between language delayed children and non-language delayed children for the variables under investigation; male-female differences in the non-language delayed group; and the relationship of test-retest conditions for the 10 dichotic measures. Appendix E indicates subjects' ages, scores obtained by each subject on the 10 dichotic measures investigated for test and retest conditions, plus Illinois Test of Psycholinguistic Abilities and the Columbia Mental Maturity Scale scores.

Comparison of Language Delayed and Non-Language Delayed Subjects

The performance of language delayed and non-language delayed subjects on 10 measures (REC, LEC, TC, R-L, POC, POE, SC-R, SC-L, DC, and NC) was investigated for both test and retest conditions. Comparison of absolute values between the two groups revealed no significant differences, as indicated in Table 1. However, when comparing ear differences within each group, significant right ear advantages were obtained.

TABLE 1

A COMPARISON OF MEAN TEST AND RETEST PERFORMANCES OF LANGUAGE DELAYED AND NON-LANGUAGE DELAYED SUBJECTS WITH REGARD TO 10 MEASURES OF DICHOTIC LISTENING ABILITY

	Group	$\overline{X}$	SD	$\overline{X}$ Diff.	t-value
REC[1]*	Lang. Delayed	30.0	4.4	3.8	-1.62 NS
	Normal	33.8	5.8		
REC[2]	Lang. Delayed	31.4	2.4	1.6	-0.66 NS
	Normal	33.0	7.0		
LEC[1]	Lang. Delayed	27.9	3.9	.1	-0.06 NS
	Normal	28.0	4.7		
LEC[2]	Lang. Delayed	27.9	3.6	1.6	0.77 NS
	Normal	26.3	5.3		
TC[1]	Lang. Delayed	57.9	6.4	3.9	-1.24 NS
	Normal	61.8	7.4		
TC[2]	Lang. Delayed	59.3	5.6	0	0.01 NS
	Normal	59.3	10.1		
R-L[1]	Lang. Delayed	2.1	5.4	3.7	-1.24 NS
	Normal	5.8	7.5		
R-L[2]	Lang. Delayed	3.6	2.5	3.3	-1.35 NS
	Normal	6.9	7.4		
POC[1]	Lang. Delayed	51.8	4.6	2.8	-1.16 NS
	Normal	54.6	5.8		
POC[2]	Lang. Delayed	53.1	2.3	2.8	-1.26 NS
	Normal	55.9	6.7		
POE[1]	Lang. Delayed	51.8	4.4	3.4	-1.28 NS
	Normal	55.2	7.0		
POE[2]	Lang. Delayed	52.9	2.1	3.1	-1.41 NS
	Normal	56.0	6.6		

TABLE 1

(CONTINUED)

	Group	$\overline{X}$	SD	$\overline{X}$ Diff.	t-value
SC-R[1]	Lang. Delayed	21.0	3.2	1.3	-0.70 NS
	Normal	22.3	4.8		
SC-R[2]	Lang. Delayed	22.3	3.6	.2	0.13 NS
	Normal	22.1	4.0		
SC-L[1]	Lang. Delayed	19.1	4.2	2.6	1.45 NS
	Normal	16.5	3.5		
SC-L[2]	Lang. Delayed	18.3	3.7	2.5	1.18 NS
	Normal	15.8	5.6		
DC[1]	Lang. Delayed	8.4	3.3	2.7	-1.70 NS
	Normal	11.1	3.5		
DC[2]	Lang. Delayed	8.9	3.1	1.4	-0.71 NS
	Normal	10.3	5.4		
NC[1]	Lang. Delayed	10.2	4.5	.9	0.41 NS
	Normal	9.3	5.3		
NC[2]	Lang. Delayed	9.3	2.8	4.1	-0.74 NS
	Normal	11.1	6.9		

*Superscripts 1 and 2 refer to test and retest conditions.

Table 2 shows the comparison of mean right ear correct scores and mean left ear correct scores for test and retest conditions of both groups. Results show a non-significant t-value for the language delayed group indicating a lack of ear preference in the test condition. These results are similar to those reported by other investigators. The non-language delayed group revealed the expected right ear advantage at a .05 level of significance. Retest conditions, while producing the same significant right ear difference for the non-language delayed group, also revealed a significant right ear advantage for the language delayed group.

TABLE 2

A COMPARISON OF MEAN RIGHT EAR CORRECT AND MEAN LEFT EAR CORRECT SCORES FOR LANGUAGE DELAYED AND NON-LANGUAGE DELAYED SUBJECTS

	Group	Right Ear Mean	Right Ear SD	Left Ear Mean	Left Ear SD	$\overline{X}$ Diff.	t
Test	Language Delayed	30.0	4.1	27.9	3.7	2.1	1.14 NS
	Non-Language Delayed	33.8	5.4	28.0	4.4	5.8	2.6*
Retest	Language Delayed	31.4	2.2	27.9	3.4	3.5	2.7*
	Non-Language Delayed	33.0	6.6	26.3	5.1	6.7	2.6*

*p = .05

Male versus Female Performance in Non-Language Delayed Subjects

In order to compare male and female performances on the dichotic tasks, the variables described previously (REC, LEC, TC, R-L, POC, POE, SC-R, SC-L, DC, and NC) were again analyzed for the test and retest conditions. The mean score comparisons for the five males and five females from the non-language delayed group are shown in Tables 3 and 4. Table 3 indicates comparisons made on test and retest conditions in regard to mean right and left ear correct, and mean right-left ear differences. No significant differences were observed between male and female subjects with regard to right ear or left ear correct responses. Results indicated, however, a tendency for females to increase correct left ear responses in the retest condition. As indicated in Table 3, the test condition for R-L differences for males and females resulted in a non-significant t-value for the two groups. In the retest condition, a tendency toward a greater male R-L difference was reported.

TABLE 3

A COMPARISON OF MALE AND FEMALE PERFORMANCES ON TEST AND RETEST CONDITIONS IN REGARD TO MEAN RIGHT AND LEFT EAR CORRECT, AND MEAN R-L DIFFERENCE

	Sex	$\overline{X}$	SD	$\overline{X}$ Diff.	t
REC[1]	Female	33	5.7	1.6	-.47 NS
	Male	34.6	5.2		
REC[2]	Female	32.4	6.7	1.2	-.29 NS
	Male	33.6	6.5		
LEC[1]	Female	28.2	3.2	.4	.14 NS
	Male	27.8	5.4		
LEC[2]	Female	28.2	3.0	3.8	1.3 NS
	Male	24.4	5.9		

TABLE 3

(CONTINUED)

	Sex	$\overline{X}$	SD	$\overline{X}$ Diff.	t
R-L[1]	Female	4.8	3.7	2	-.44 NS
	Male	6.8	9.2		
R-L[2]	Female	4.2	6.4	5	-1.2 NS
	Male	9.2	6.5		

Similar non-significant results were found on the remaining dichotic variables tested, as indicated in Table 4.

TABLE 4

A COMPARISON OF MALE AND FEMALE PERFORMANCES ON TEST AND RETEST CONDITIONS IN REGARD TO TOTAL CORRECT, PERCENT OF CORRECT, PERCENT OF ERROR

	Sex	$\overline{X}$	SD	$\overline{X}$ Diff.	t
TC[1]	Female	61.6	8.2	.8	-1.86 NS
	Male	62.4	4.9		
TC[2]	Female	60.6	8.1	2.6	.43 NS
	Male	58.0	10.6		
POC[1]	Female	53.64	3.0	1.86	-.54 NS
	Male	55.5	7.0		
POC[2]	Female	53.58	5.7	4.74	-1.28 NS
	Male	58.32	6.1		

TABLE 4

(CONTINUED)

	Sex	$\overline{X}$	SD	$\overline{X}$ Diff.	t
POE[1]	Female	54.5	3.5	1.38	-.33 NS
	Male	55.88	8.6		
POE[2]	Female	54.2	5.7	3.6	-.95 NS
	Male	57.8	6.2		

Test-Retest Reliability

The results of the Pearson product-moment correlations of test-retest performance for total right ear correct, and total left ear correct, for language delayed and non-language delayed subjects are shown in Table 5. Performances between test and retest conditions for both groups revealed non-significant relationships between the conditions. These results suggest the lack of reliability for predicting ear perference through the use of dichotic listening tasks. Similar non-significant test-retest reliability coefficients were found on the remaining variables tested.

TABLE 5

TOTAL RIGHT EAR CORRECT, TEST VS. RETEST, AND TOTAL LEFT EAR CORRECT, TEST VS. RETEST FOR LANGUAGE DELAYED AND NORMAL SUBJECTS

Group	Right Ear Correct Test vs. Retest	Left Ear Correct Test vs. Retest
Lang. Delayed	.24 NS	-.16 NS
Normal	.18 NS	.11 NS

Discussion

This study was designed to investigate dichotic listening performance between language delayed and non-language delayed children. The results of this investigation may be summarized as follows:

1. A comparison of absolute measures between the two groups revealed no significant differences for all variables investigated. Comparisons made within each group showed a right-ear advantage for the non-language delayed subjects on test and retest conditions, while language delayed subjects showed a lack of ear preference in the test condition, and a significant right-ear advantage when retested.

2. No significant differences in performance were found between male and female subjects in the non-language delayed group.

3. No relationship was found between test and retest performances for language delayed or non-language delayed subjects.

Concerning the few dichotic studies conducted on language delayed children, results have shown either a left-ear advantage (Sommers and Taylor, 1972) or a lack of ear preference (Helms, 1971) when comparing mean right and left ear correct scores. In contrast, the results of the present study indicated a trend toward a significant right-ear advantage on the test condition, and a significant right-ear effect on the retest condition for the language delayed subjects. A comparison of the Helms, Sommers and Taylor, and present study shows that a similarly defined sample of language delayed subjects existed, along with a corresponding number of subjects, in the three studies. The major difference among the studies in question was the type of dichotic stimuli used. Helms employed digit pairs and animal names; Sommers and Taylor used word and digit pairs. Nonsense CV syllables were used as stimuli in the present study. Considering the fact that nonsense CV syllables may be processed at a level different from words or digits, it is not surprising that varying results were observed between the Helms, Sommers and Taylor, and the present investigation. Furthermore, a suggestion by Porter and Berlin (1975) that nonsense CV syllables may reflect auditory or phonetic processing lends support to the previous statement regarding differences in levels of language processing. This suggestion could offer a possible explanation for the right-ear advantage obtained in this study for language delayed subjects, as opposed to a lack of ear preference or a left-ear advantage reported in other investigations utilizing language delayed samples. Dichotically presented words and digits may place more of a demand on word recognition, semantic, and memory processes, thus reducing the possibility of observing an ear advantage.

A comparison of test performance alone, between the present study and those of Helms, and Sommers and Taylor, reveals a lack of ear preference for language delayed subjects, as reported by Helms, and a significant right-ear advantage for non-language delayed subjects, as reported by Sommers and Taylor. The right-ear advantage obtained by language delayed subjects on the retest condition in the present study, suggests that the language delayed child is able to function similar to normals on a dichotic CV syllable listening task, presumably at a phonetic level of processing. If, indeed, the added factors of memory, recognition, and semantic involvement are present in verbal dichotic stimuli, other than nonsense CV syllables, the child experiencing difficulties in the processing of language would perhaps demonstrate the lack of ear preference or a left-ear advantage as reported in the Helms, and Sommers and Taylor investigations. When given a second chance to perform on the dichotic CV syllable task, language delayed subjects in the present study obtained results similar to normal subjects. A language delay may place some restrictions on a child so that a warm up or familiarity with subject matter is necessary before an accurate measure can be taken.

It should be noted here, that although comparisons are being made between the present study and other dichotic investigations, the lack of reliability observed in this study would indicate that any similarities or differences observed in test results could be related to a chance occurrence.

Since no retest studies on language delayed subjects have appeared in the literature, a true comparison cannot be made between the results of this investigation and others. Increased familiarity with the task may have created the observed right-ear advantage on the retest for language delayed subjects.

With regard to male-female performance, this investigation revealed no significant differences between the two groups in the non-language delayed sample. These results are in agreement with Kimura (1963) who reported a non-significant sex difference for the right-ear effect in subjects ranging in age from four to nine, and Geffner and Hochberg (1971), who reported a similar non-significant relationship between sexes on the tasks investigated. Kimura, however, found a significant difference between boys and girls in over-all efficiency on the task at ages five and six. This difference disappeared at age seven.

In an investigation similar to the present study, Johnson (1974) observed in young adults, that females more accurately reported stimuli presented to the left ear, had greater TC and DC scores, and fewer NC than males. An even greater number of statistically significant differences were revealed on retest. Left ear correct, TC, and DC scores for females remained greater than for males, while R-L, POC, POE, and Sc-R socres were significantly greater for males on retest.

Although the results from the present study failed to reach significance on measures tested for male-female differences, a comparison was made between the Johnson study and this investigation. Upon retest, the females in the present study had a tendency to report greater left ear correct scores than males. This in turn reduced the R-L difference in the females on retest, resulting in a difference which approached significance when comparison was made between males and females on mean R-L differences for the retest condition. Perhaps the greater over-all efficiency of females reported by Kimura (1963), and the tendency towards a significant female superiority in the present study can be related to the adult female superiority reported in the Johnson study. Due to the lack of research reported in this area, possible explanations as to its occurrence, are at best tenuous.

The question still remains as to why a significant male-female difference was not revealed in the present study. The Johnson study and the present investigation were conducted in the same laboratory, using the same dichotic stimuli tape, following basically the same experimental procedures. The Johnson study employed a larger N (N = 50) which one would expect to yield more consistent trends by reducing the effects of variability. Another possibility for discrepancies in results would be the difference in the samples employed. The Johnson study used adults ranging in age from 18 to 35 years. The present study contained children from the ages of five to 10. It is possible that dichotically presented CV syllables may create a more difficult task for young children of both sexes. This possibility is supported by the test-retest reliability findings.

The results of the present study, with regard to listener reliability, indicate that performance on one occasion had no statistically significant relationship to performance on a later occasion for any measure investigated. These results are in complete disagreement with those of Ryan and McNeil (1974), and Johnson (1974). Discrepancies, however, are also found between the Ryan and McNeil study and the Johnson study. These two investigations and the present study were conducted in the same laboratory, following similar procedures, and using the same dichotic tape. Ryan and McNeil found a relatively high correlation for REC^1-REC^2

LEC^1-LEC^2. The Johnson study correlation coefficients were remarkably different from the Ryan and McNeil study, and results of the present study were considerably different from results of the Johnson investigation. Differences in subject number, age, and task difficulty could have affected the outcome of the present investigation as compared to the Ryan and McNeil, and Johnson studies. Additionally, in the present study, there were four reversals of ear preference from test to retest in the non-language delayed group, and three reversals in the language delayed group. Taken together, these results cast doubt on the reliability of predicting laterality or any measure of cerebral dominance from dichotically presented stimuli, especially in young children.

Dichotic listening tests are currently thought to be a promising technique for the assessment of centrally processed speech and asymmetry of brain functions. It is suggested that any interpretations with regard to results of dichotic listening experiments be cautiously made. A review of the literature reveals many discrepancies between investigations and, as this study reveals, differences from within the same experimental setting under similar conditions. Discrepancies in subject number and type of dichotic measure employed constitute only two of the numerous differences existing throughout the literature.

Therefore, from the results of the present investigation, and in consideration of other dichotic experimentation, the use of dichotic listening in children, whether non-language delayed or language delayed is discouraged. The disparity present in investigations concerned with normal adult subjects involved in dichotic experimentation must be resolved before this measure can be considered a valid tool in assessing language processing.

CHAPTER IV

SUMMARY AND CONCLUSIONS

Summary

Investigations employing dichotic verbal stimuli, the simultaneous presentation of speech signals to the two ears, have provided evidence that normal subjects tend to report those stimuli presented to the right ear more accurately than those to the left ear. The presence of a right ear superiority for verbal stimuli suggests a dominant left hemisphere for speech, based on the theory of strong contralateral auditory pathways.

The present study was designed to compare the performance of language delayed and non-language delayed children on a nonsense CV syllable task. The reliability of test-retest performance on the task, and male-female performance differences were also examined.

Subjects consisted of nine language delayed and 10 non-language delayed children from the ages of five to 10. All participants were native speakers of English, reported no history of brain pathology, and demonstrated normal and symmetrical hearing.

Thirty pairs of natural speech CV syllables representing all possible combinations of PA, TA, KA, BA, DA, and GA, served as test stimuli. Each child was tested twice with identical stimuli and test conditions. The retest was administered from within two weeks to one month after the initial session.

The following measures were used to assess subject performance: right ear correct, left ear correct, total correct, R-L difference, percent of correct, percent of error, double correct and neither correct. T-test analysis was used as the method to compare mean differences within each group and between groups, and to analyze male-female differences in the non-language delayed group. The Pearson product-moment correlation coefficient was used to examine test-retest reliability.

The results obtained in the present study may be summarized as follows:

1. A comparison of absolute measures <u>between</u> the two groups revealed no significant differences for any variable investigated. Comparisons made <u>within</u> each group showed a right-ear advantage for the non-language delayed subjects on test and retest conditions, while language delayed subjects showed a lack of ear preference in the test condition and a significant right-ear advantage when retested.

2. No significant differences in performance were found between male and female subjects in the non-language delayed group.

3. No relationship was found between test and retest performances for language delayed or non-language delayed subjects.

Conclusions

The lack of significant differences reported between the language delayed subjects and non-language delayed subjects of this experiment contradict results previously reported in the literature. Comparisons made within the non-language delayed group disagree with results obtained in the same laboratory under similar experimental conditions.

Due to the great amount of variability reported in the literature, a possibility exists that dichotic listening is not simply a measure of central language processing. Other factors appear to be affecting performance on the task and interactions of various levels of language processing may be involved. Further, the lack of reliability exhibited in this investigation provides a strong argument against the use of dichotic listening as a method for assessing language function in children.

Suggestions for Future Research

As a result of the findings observed in the present study, the following suggestions are made for further research:

1. A comparison of dichotic verbal stimuli and the test-retest relations observed in adult subjects for varied stimuli.

2. Replication of the Johnson study comparing male and female performance differences on a verbal dichotic CV syllable listening task.

3. An investigation comparing the performance of a large group of normal children on dichotically presented digits, words, and CV syllables, and the relationship between test-retest reliability on the stimuli presented.

APPENDICES

APPENDIX A

SUBJECT INFORMATION FORM

Name ______________________________ Date ________________

Address ____

Age ________ Date of Birth ________________ Phone ____________

DOES YOUR CHILD WRITE WITH HIS RIGHT OR LEFT HAND? ___________

HAS YOUR CHILD HAD ANY BRAIN DAMAGE OR HEAD TRAUMA AT ANY TIME? (If so, please explain) ______________________________

____

HAS YOUR CHILD HAD ANY PREVIOUS TRAINING IN LISTENING TO SIMULTANEOUS MESSAGE TASKS? (If so, please explain) ________

____

HAS YOUR CHILD HAD ANY PREVIOUS HISTORY OF A HEARING LOSS?

____

APPENDIX B

Subjects' Test Instructions

You are about to hear 12 syllables through your ear-phones from the group on the chart in front of you. The syllables you will hear are BA, DA, GA, PA, TA, KA. You will hear the first six syllables through one of your earphones, followed by the last six through the other earphone. I want you to point to the syllables that you hear on the chart in front of you.

After presentation of the discrimination test the following instructions were read: You are now going to hear 30 pairs of syllables from the same group, BA, DA, GA, PA, TA, KA. From now on there will always be two syllables at the same time - one to your right ear and a different one to your left ear. You must point to two different answers on the chart as soon as you hear the syllables. It is very important to point to two answers even if you think you hear only one syllable. You must guess at the other syllable if you only hear one. Are you ready?

APPENDIX C

<u>Pre-Test</u>

Name ____________________

Date ____________________

Condition ____________________

CH. I ____________________

CH. II ____________________

Tape ____________________

PA, TA, KA, BA, DA, GA

Right	Left
1. ______	1. ______
2. ______	2. ______
3. ______	3. ______
4. ______	4. ______
5. ______	5. ______
6. ______	6. ______

1.	______	______	16.	______	______
2.	______	______	17.	______	______
3.	______	______	18.	______	______
4.	______	______	19.	______	______
5.	______	______	20.	______	______
6.	______	______	21.	______	______
7.	______	______	22.	______	______
8.	______	______	23.	______	______
9.	______	______	24.	______	______
10.	______	______	25.	______	______
11.	______	______	26.	______	______
12.	______	______	27.	______	______
13.	______	______	28.	______	______
14.	______	______	29.	______	______
15.	______	______	30.	______	______

APPENDIX D

PERMUTATIONS

Condition	Tape Channel	Tape Head	Audiometer Channel	Ear Channel	Ear-Phone	Ear
1	I	A	1	R	Red	R
	II	B	2	L	Blue	L
2	I	A	2	R	Red	R
	II	B	1	L	Blue	L
3	I	A	1	L	Blue	R
	II	B	2	R	Red	L
4	I	A	2	L	Blue	R
	II	B	1	R	Red	L
5	I	A	1	R	Red	L
	II	B	2	L	Blue	R
6	I	A	2	R	Red	L
	II	B	1	L	Blue	R
7	I	A	1	L	Blue	L
	II	B	2	R	Red	R
8	I	A	2	L	Blue	L
	II	B	1	R	Red	R

APPENDIX E

TEST AND RETEST SCORES FOR LANGUAGE DELAYED AND NON-LANGUAGE DELAYED SUBJECTS ON DICHOTIC MEASURES, THE ITPA AND COLUMBIA

Group	Subject	Age	REC^1	REC^2	LEC^1	LEC^2	TC^1	TC^2	$R\text{-}L^1$	$R\text{-}L^2$
Lang. Delayed	1	6-4	25	32	26	28	51	60	-1	4
	2	6-4	24	32	23	30	47	62	1	2
	3	6-8	36	32	22	32	58	64	14	0
	4	10-7	37	32	32	32	69	64	5	0
	5	7-3	30	31	30	26	60	57	0	5
	6	5-6	28	28	31	22	59	50	-3	6
	7	7-9	29	32	33	29	62	61	-4	3
	8	8-6	32	36	28	29	60	65	4	7
	9	7-1	29	28	26	23	55	51	3	5
Non-Lang. Delayed	1	7-4	38	44	22	25	60	69	16	19
	2	8-9	31	42	26	32	57	74	5	10
	3	5-4	29	29	27	29	56	58	2	0
	4	7-4	31	31	38	26	69	57	-7	5
	5	5-7	24	34	26	24	50	58	-2	10
	6	7-6	43	38	25	29	68	67	18	9
	7	8-1	32	26	27	13	59	39	5	13
	8	6-0	32	23	25	26	57	49	7	-3
	9	8-0	40	27	31	31	71	58	9	-4
	10	6-2	38	36	33	28	71	64	5	8

APPENDIX E

TEST AND RETEST SCORES FOR LANGUAGE DELAYED AND NON-LANGUAGE DELAYED SUBJECTS ON DICHOTIC MEASURES, THE _ITPA_ AND _COLUMBIA_

Group	Subject	POC^1	POC^2	POE^1	POE^2	$SC\text{-}R^1$	$SC\text{-}R^2$	$SC\text{-}L^1$	$SC\text{-}L^2$	DC^1	DC^2
Lang. Delayed	1	49.0	53.3	49.3	53.3	19	26	20	22	6	6
	2	51.1	51.6	50.7	51.7	21	20	20	17	3	12
	3	62.1	50.0	61.3	50.0	28	21	12	20	9	12
	4	53.6	50.0	54.9	50.0	18	22	23	22	14	10
	5	50.0	54.4	50.0	54.0	22	23	22	18	7	8
	6	47.5	56.0	47.6	54.3	23	25	19	18	8	3
	7	46.8	52.5	46.6	52.5	21	20	25	17	7	10
	8	53.3	55.4	53.3	56.7	20	28	17	10	10	7
	9	52.7	54.9	52.3	53.6	17	16	14	21	12	12
Non-Lang. Delayed	1	63.3	63.8	63.3	68.6	28	27	13	9	8	16
	2	54.3	59.5	54.0	60.9	24	22	19	14	7	18
	3	51.8	50.0	51.6	50.0	20	22	18	22	8	6
	4	44.9	54.4	43.1	54.0	17	18	23	13	11	13
	5	48.0	58.6	48.5	58.1	16	28	18	19	8	5
	6	63.2	56.7	67.3	58.5	31	20	12	11	12	18
	7	54.2	66.7	54.1	58.0	23	21	18	8	9	5
	8	56.1	46.9	55.6	47.9	18	16	12	19	13	7
	9	56.3	46.6	59.2	46.8	23	20	14	24	17	7
	10	53.5	56.3	55.1	57.1	23	27	18	19	15	8

APPENDIX E

TEST AND RETEST SCORES FOR LANGUAGE DELAYED AND NON-LANGUAGE DELAYED SUBJECTS ON DICHOTIC MEASURES, THE ITPA AND COLUMBIA

Group	Subject	NC^1	NC^2	Scaled Score Mean of ITPA	Columbia
Lang. Delayed	1	14	6	28	117
	2	16	10	29	104
	3	9	8	27	109
	4	.5	.6	27	104
	5	7	11	28	123
	6	9	14	28	124
	7	5	7	28	113
	8	10	12	29	108
	9	17	10	29	120
Non-Lang. Delayed	1	9	7	28	94
	2	9	4	38	100
	3	13	8	54	137
	4	4	16	42	103
	5	18	7	35	133
	6	4	11	43	126
	7	10	26	41	114
	8	17	18	41	116
	9	5	9	44	136
	10	4	5	52	129

APPENDIX F

DICHOTIC CV TEST STIMULI

	Channel I	Channel II
1	DA	TA
2	BA	PA
3	GA	TA
4	TA	KA
5	TA	BA
6	GA	KA
7	KA	TA
8	DA	GA
9	PA	DA
10	KA	GA
11	KA	DA
12	GA	BA
13	BA	GA
14	BA	TA
15	DA	BA
16	BA	KA
17	PA	GA
18	GA	PA
19	PA	TA
20	TA	DA
21	KA	PA
22	DA	PA
23	KA	BA
24	PA	KA
25	PA	BA
26	GA	DA
27	DA	KA
28	BA	DA
29	TA	GA
30	TA	PA

APPENDIX G

SPEECH DISCRIMINATION
TEST STIMULI

CV SYLLABLES			
Channel I		Channel II	
1	DA	1	KA
2	BA	2	GA
3	GA	3	BA
4	TA	4	DA
5	KA	5	PA
6	PA	6	TA

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