Review on Audiological Evaluation of Learning Disabled

Reg No. M 9621

An Independent projects submitted as part fulfilment for the First Year M.Sc. (Speech and Hearing) to the University of Mysore.

May 1997

ALL INDIA INSTITUTE OF SPEECH AND HEARING
Mysore - 570 006

VECLARATI0N

Hereby *declare that this lndependent Project entitled* **"REVIEW *ON AUDIOLOGICAL EVALUATION Of LEARNING DISABLED is the*** *result of my own study under the able guidance of* **MRS. VANAJA,** *Lecturer in Audiology. All India Institute of Speech and Hearing, Mysore, has not been submitted earlier to any University for any other diploma or* degree.

Mysore

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DEDICATED TO

MY LORD JESUS

Who Has Been The Silent Observer, listener, Comforter, Friend And Everything Of All My Pains, Tears, Hurts And Joy All These Years And Also TO MY FAMILY, Dad, Mom, Jimcha, Manjuma And Kuttan For Being The Strength And Support Of My Life Always !!

CERTIFICATE

This is to certify that thz Independent Project entitled **"REVIEW ON *AUDI0L0G1CAL EVALUATION Of* LEARNING *DISABLED"*** *i& a bonafide work in part fufillment for the first year* M.Sc. *in Speech and Hearing of the student with* Reg. No. M*9621.*

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DIRECTOR
All India Institute of
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GUIDE

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all your advices, scoldings, surprises ... Thank you for helping mz grow up and still after so many years earing enough for this unrelated sister !

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CONTENTS

INTRODUCTION

"Normal yet abnormal; Able yet disabled in many areas are the learning disabled"

Everybody has an imperfect ability in some area or another. Are all learning disabled ? Many argue that process disorders are difficult to assess and that it is difficult to differentiate those with LD from those who are having other disabilities. 'Puzzling' is a term teachers use to describe students with LD. But all are imperfect and yet normal, so is it fair to term them abnormal. May be it is as one those who has the problem reflects it thus, "that is to say I was completely frustrated, completely at odds with my environment, a sort of fake who believed he was somebody, but could furnish no evidence to prove it".

Language is something that goes on inside a person and thus cannot be watched as it happens, only the results can be seen not the process of language and so it continues to have the awe inspiring quality of a miracle. Many have tried to define LD in vain. LD is a general term that refers to a heterogenous group of disorder manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or mathematical abilities. These disorders are intrinsic to the individual presumed to be due to CNS dysfunction and may occur across a life span (NJCLD, 1988).

What is an auditory processing problem and how does it contribute to an overall learning disability ? Auditory perceptual problems can undoubtedly exist with LD because of factors like neurological problems, social conditions, of poverty, brain damage, from head trauma, peripheral hearing loss, drug abuse, etc. While these factors should be adequately identified when assessing auditory perceptual abilities, they should not be used as excuses to exclude a child from an auditory language remediation program.

Both mild and moderate auditory processing deficits will emerge as problems when the child enters school and is required to learn audiotorily under less favourable listening conditions. A test might be done to rule out a hearing loss, but when that is eliminated, the presence of a central auditory problem might not be considered.

Thus it is important to keen mind that a single hearing test may not be adequate A thorough evaluation of central auditory abilities should be performed.

Thus the audiological evaluation could include a test battery to evaluate a child's ability to respond under different conditions of signal distortion or competition tests to evaluate centarl auditory disorrders are constructed based on the principle that assumes a normal listener can tolerate mild distortions of speech and still understand it. A listener with an auditory processing deficit will encounter difficulty with the distorted speech due to added "internal distortion".

The current emphasis on central auditory assessment with LD children has grown out of a need to identify subtle auditory deficits that might be interferency with academic work or with social communication skill (Brand and Musiek, 1991). There is considerable evidence indicating a relationship between learning disabilities and poor performance on auditory tests (Katz and Illmer, 1972). A variety of tests such as dichotic speech tests, Bineural fusion, masking level difference, ABR, MLR, LLR, P_{300}, time compressed speech test, filtered speech test, SSW, etc. are used to assess central auditory disorders in learning disabled children. Test batteries do not necessarily need to be extensive because 2 or 3 appropriately selected tests often can be as well as a battery of 6 or 7. At a minimum a central auditory test battery should include the following testing brain stem auditory function and tests of cortical hemispheric and interhemispheric function including both verbal and non-verbal materials. Its preferable to include both objective and sublective tests. Ultimate decision regarding the tests to be administered will depend on the presenting complaint of client, eye of subject, existing medical documentation, that may indicate probable site of lesion and the audiologists insight into the possible problem from his/her experiences with CNS assessments.

Need for the study

The studies focussing on central auditory disorders in children and adults with learning disability are published in various journals.

The present study attempts to put together the information available in the literature with the view of

Improving the knowledge about central auditory processing problems seen in subjects with learning disability.

METHODOLOGY

Aim of the study

To review the various articles on LD and see the trend in

1. The patients tested {children/adults)
2. Tests most frequently used
3. Tests that are effective in detecting central auditory processing disorder in learning disabled.

The journal articles dealing with hearing disability in both children and adults were selected for the study. The articles were collected from various journals available in the library and information centre of All India Institute of Speech and Hearing. The journals reviewed include

1. Journal of learning disabilities
2. Ear and hearing
3. Brain and language
4. Journal of auditory research
5. Journal of speech and hearing research
6. Journal of speech and hearing disorders
7. Scandinavian Audiology
8. Journal of Acoustical Society of American Society
9. Audicebel
10. British Journal of Audiology

The information from these articles were classified under the following variables and were tabulated as:

1. Author and year
2. Subject variables
3. Stimulus variables
4. Type of presentation
5. Tests used
6. Procedures used is described in Appendix
7. Results

The articles reviewed for the study are labulated in teh following pages:-

Author & year	Subject variables	Stimulus variables	Type of presentation	Tests	Procedures	Results
Chermak D.G. Vonhof R.M. Bendel B.R. (1989)	8 LD adults 8 normal 18-30 years	Monosyllabic words speech spectrum noise	Dichotic	Dichotic speech test	Table 21	LD subjects performed poorer than that of normal under each masking condition
Ferre M.J. Milber L.A. (1986)	13 normal 13 LD 8-12 years	Monosyllables pure tones noise	Dichotic	PTA (250-4 kHz) Tympanometry time compressed speech test Binormal fusion low pass filtered speech	Table 14 Table 17 Table 18 Table 19	Performance of LD children significantly poorer in all the tests, but low pass filter speech test was most sensitive in detection of CAD
Jirsa R. Clontz K. (1989)	24 children normal & LD 9.2-11.6 yrs	Tone pips P_{300} clicks for ABR	Monotic	PTA, ABR P_{300}	Table 11 Table 15	Significant latency increase of the N_1. P_2 & P_3 components. Interpeak latency significantly longer in LD ABR showed normal finding
Hynd G. Obrzut J. (1983)	Normal & LD 6-12 years	CV syllables noise	Dichotic	Dichotic CV test	Table 16	The LD children performed poorly compared to normals

Author & year	Subject variables	Stimulus variables	Type of presentation	Tests	Procedures	Results
Roush J. Talt A.C. (1989)	18 normal 18 LD 6-12 years	Clicks pure tones noise	Diotic & dichotic	Binaural fusion MLD ABR	Table 14 Table 15	Binaural fusion test showed lower overall score for diotic and dichotic conditions. MLR and ABR responses were not significantly different for two groups
Rosner R. Morrow M. (1983)	32 normal 6 yrs 6 mon 17 LD 9.3 years	CV nonsense syllables	Dichotic	PTA tympanogram dichotic CV test	Table 16 Table 17	Children with LD showed poorer scores in dichotic syllable test
Johnson W.D. Enfield L.M. Sherman E.R. (1981)	91 children normal & LD 6-12 years	Words noise	Dichotic	PTA tympanogram SSW, CES	Table 1 Table 24	LD poor performance on SSW test Poor performance on CES nonverbal listening task
Farrer M.S. Keeth W.R. (1981)	LD and normal 5-9 years	PBK word list	Dichotic	PTA filtered word test low pass filtered at 1 k and 750 Hz	Table 2	There was complete separation between normal and LD for 1 kHz filtered condition but overlap in unfiltered condition

Author & year	Subject variables	Stimulus variables	Type of presentation	Tests	Procedures	Results
Jerger 5. Jerger J. (1981)	l11/2 year old LD group	Clicks phonemes pure tone monosyllabic words	Monotic	MLR, LLR ABR tympanometry phoneme repetition skill Word discrimination skill Word identification skill	Table 3 Table 15 Table 17	Phoneme repetition skill and word discrimination and identification effected in children with LD. ABR waveform of right ear appeared degraded for peak wave I, II and III MLR waveform morphology exhibited poor definition for both ears LLR normal and well formed both ears
Hynd W.G. Obrzut A. Obrzut J. Leitgeb L.J. (1980)	48 normal 48 LD 7-10 years 10-11 years	30 pairs of CV syllables	Dichotic	PTA dichotic CV test	Table 20	LD had reduced tapping rate for the syllables normals able to process concurrent task than LD
Swanson M. Chochran T. (1991)	18 normal 18 LD 9-10 years	Monosyllabic words	Dicbotic	PTA dichotic word test	Table 16	Children with LD showed lower score and more diffused selective attention to word feature than normal
Obrzut E.J. Obrzut A. Bryden P.M. Bartels G.S. (1985)	16 normal 16 LD 7-12 years	CV syllable	Dichotic	PTA dichotic CV test	Table 14	LD showed weaker right ear advantage

Author & year	Subject variables	Stimulus variables	Type of presentation	Tests	Procedures	Results
Bauer R. (1971)	*7 normal 7 LD 10 years*	*Digits from 1-9*	*Dichotic*	*Digit sequencing test*	*Table 5*	*Low amount of recall was found in LD*
Manning H.W. Johnston L.K. Beasley S.D. (1977)	*20 LD children 8 years*	*Spondees PBK list*	*Monotic*	*PTA time compressed speech test*	*Table 6*	*Performance decreased at 60% time compression and 0 time compression but same as normals in 30% compression*
Lasky Z.E. Tobin H. (1973)	*11 normal and LD 8 years*	*Broad band white noise Linguistic and non-linguistic message*	*Dichotic*	*Performance task*	*Table 7*	*Performance of LD children was intefered when linguistic competing auditory message was presented*
Fournier R.5. Berrick M.J. Shlibou F.G. Shultz CM. Hughes P.J. Freed H. (1984)	*93 normals 97 LD 8-11 years*	*Pure tone EC word list noise*	*Dichotic*	*PTA tympanometry speech recognition test SSW*	*Table 1*	*Performance of LD was poorer than the normal Speech recognition test 88%*

Author & year	Subject variables	Stimulus variables	Type of presentation	Tests	Procedures	Results
Watson U.B. (1992)	25 normal 20 LD 18-20 years	CV nonsense syllable pure tone	Dichotic and monotic	PTA pitch discrimination test temporal order test syllable sequence test syllable identification test	Table 8	LD performed poorly on temporal task Other tests were not significant
Cermak 5.L. Goldberg J. Chemak S. Brake C. (1980)	Normal and LD 8-14 years	Monosyllabic	Monotic	Word recall test	Table 9	Performance of LD children was similar to normals
Watson U.B. Statler T. (1985)	20 LD of 8 years to 12.8 years	Sentences	Monotic	Carrow auditory visual ability test	Table 22	LD children showed evident, developmental delay in their auditory processing capacity

Author & year	Subject variables	Stimulus variables	Type of presentation	Tests	Procedures	Results
Windham R. (1985)	40 LD and normal 7-10 years	Sentences noise pure tone	Monotic and dichotic	SSW bineural fusion filtered speech test Alternating sentence test	Table 1 Table 2 Table 14	SSW - The left ear score from competing sentence test differentiated LD from normal and other tests were not significant
Croskey L.R. Thompson W.N. (1973)	20 LD 5-17 years	Simple declarative sentences	Monotic		Table 23	LD showed poor comprehension as the rate of speech increased
Lasky Z.E. Jay B. Ehrman H.M. (1975)	20 normal and LD 7-10 years	Words nonsense syllable environmental sound and pure tone	Monotic		Table 10	LD performed poorer than than normals on recall of words, pure tones. No significant difference in recall of nonsense syllable and environmental sound
Jirsa E.R. Clontz B.K. (1990)	24 LD 9.2-11.6 yrs	Tone pips sentences	Dichotic	Pitch pattern sequence test selective auditory test competency test ABR	Table 11 Table 15	Selective attention test most sensitive Other tests were not significant ABR significant latency increased for N1, P3 and p_3 components P3-P3 interpeak latency is longer

Author & year	Subject variables	Stimulus variables	Type of presentation	Tests	Procedures	Results
Qberzut J. Nicholson C. (1994)	*48 normal 48 LD 6-12 years*	*CV syllable simple square wave and complex square wave tones*	*Dichotic*	*Dichotic CV test*	*Table 16*	*Boarder line significant obtained for tonal stimuli No significant differences obtained for other stimuli*
Mathews J.A.B. Seymour M.C. (1982)	*87 normal and LD 7-8 years*	*Sounds and words*	*Monotic*	*Ohio test of articulation and percep- tion of sounds and words*	*Table 12*	*Poor auditory discrimination in LD group*
Mcnutt C.J. Janice L.Y.C. (1982)	*10 LD 10 normal 8-11 years*	*13 sentences with 5-7 morphemes*	*Monotic*	*Compression speech test*	*Table 9*	*LD group were less accurate at fastest rate (60% compression) but equally at all other rates*
McGroskey L.R. Kidder C.H. (1982)	*135 normal and LD 7-9 years*	*Pure tone pulses*	*Dichotic*	*Binaural fusion test*	*Table 14*	*Short time interval affected auditory fusion of LD group*
Kreshner J. Micallef J. (1992)	*30 LD 11.3 years*	*30 pairs of CV syllable*	*Dichotic*	*Dichotic listening task*	*Table 13*	*LD were less lateralised for CV combination. Poorer in CV recall from right ear and superior in CV recall from left ear*
Masters L. Mash E.G. (1978)	*108 LD 6-12 years*	*Pure tones*	*Monotic*	*Tympanometry*	*Table 17*	*Higher proportion of LD seen with middle ear pathology*

RESDLTS

Purpose served by articles

I. Articles

	Number	Percentage
Total number of articles	2?	
Number of articles with only LD	7	24.1
Number of articles with both normal and LD	22	75
Number of articles with only adults	4	13
Number of articles with only children	25	86

II. Showing the type of testing used and the tests found to be effective in detecting central auditory disorders

Tests	Number of times tests seen in each study	%	Number of times tests found positive	
1. Dichotic CV tests	9	31	9	31
2. Bineural fusion	4	13	2	6.8
3. ABR, MLR, LLR, P_{300}	4	13	2	6.8
4. MLD	1	3.4	1	3.4
5. Time compressed speech test	3	10	2	6.8
6. Filtered speech test	3	10	2	6.8
7. SSW	2	6.8	2	6.8
8. Other tests	7	24	7	24

III. Different journal in which the articles were published

	Number	Percentage
JLD	10	34
E&H	6	20
JAR	2	6.8
B&L	5	17
JSHR	3	10
N.PLY	2	6.8
JSHD	1	3.4

SUMMARY AND CONCLUSION

A review of the studies published on audiological evaluation of the learning disabled showed the following trends:

1. More number of children were tested when compared to adults in all studies.

2. Comparative studies were more than concerning only learning disabled.

3. Dichotic speech tests was the most frequently used test followed by bineural fusion test.

4. Results of a majority of the studies revealed that dichotic speech tests was most sensitive in detecting central auditory processing disorder in learning disabled.

5. A majority of the articles on audiological evaluation on the learning disabled were published in the journal of learning disabilities.

6. About 2% of the articles did not clearly specify the age, stimulus, variables and procedures used in their study.

7. Only 5% of studies were conducted on adults with auditory perceptual problems.

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APPENDIX

Table 1

The SSW is composed of two spondiac words presented one to each ear at 50 dBSL with the words staggered so that the second syllable of one word is simultaneous with the first syllable of the other. The task require the subject to repeat words presented to both the ears.

Table 2

Test material consisted of filtered and unfiltered version of PBK list 1. Three low pass filters with cutoff frequency of 1000 Hz, 750 Hz and 500 Hz and with a rejection rate of 18 dB/octave were used to filter the material. First the unfiltered speech material was presented then six random variations of low pass filtered speech. All the discrimination test were administered at 50 dBHL.

Table 3

Phoneme discrimination skills: 33 idfferent pairs of consonants differing in only one distinctive features. The set of survival pains assessed discemination of phonemes contrasting in seven different binary distinctive features (voicing, labiality, continuance," back/front, sibilancy, sonoramy nasality). All possible CV pairs were randomized yielding a recorded seven of 132 trials. The inter-item interval was 6 sees. The carrier phrase was "Number ...". The listeners task was to indicate whether the CV pairs were same or different in a two alternative forced choice method.

Phoneme identification

Set of CV stimuli that were generated on speech synthesizer the CVs were these forment patterns that differed in acoustic parameters of voice onset time. The VOT ranged from 0-70 msec in 10 msec increments presented monoaurally. The subject labelled each that he heard as 'ba' or 'pa'.

Phoneme blending

Componentsd-g words presented in isolation in the correct order subject responded with the word that was formed by combining the ordered sounds.

Phoneme repetition

Nonsense words consisting of 1-3 syllables.

Word discrimination

Specially constructed picture word test subject tas was to decide whether an orally presented word matched a picture on a two alternative forced choice method.

Word identification

Set of monosyllabic words materials PAL PB-50 and tests NV-ships. Tape recorded stimuli monoaurally presented.

Table 4

Each child was presented strip of tag board on which the CV syllables were presented for the dichotic task. The examine then pronounced each CV syllable with the subject repeating it orally. All subjects received the following instruction, "ou will hear a word in one ear and another in the opposite ear and it will sound like people talking at the same time." These sets of the 30 beats were given, one condition involved free recall another involved directed right ear report and third condition reflected directed left ear report. The order of presentation was counter balanced for all six combination. Instruction was to report what is heard in the right ear only. In addition, hemasptial body field was controlled for by having each subject maintain their lateral gaze to the external space to the right of body mid line.

Table 5

Sequence of six digits from 1-9 were taken from a random number table and those more than two digit in ascending order or with one digit appearing more than twice were eliminated. 61 sequences was selected and one was randomly selected as the repeated sequence. Total of 80 trials with repeated sequence occurred every fourth trial on the average. Prior to test children wer einstructed. A sequence was presented followed by 'now' and the subject reported the digit back as instructed. Subjects were given practice trials and not allowed to use hierarchial grouping but to report digits individually.

Digits were presented at approximately one per second in a monotone voice. The cue for recall followed the last digit in the sequence by seconds plus or minus one second.

Table 6

The three time compression condition were presented to each of the 20 subjects in a counter balanced order with the PBK 50 word test I presented first, test 2 second and test 3 last. All tapes were presented in sound field at 32 dBSL. During test sessions, the listener was seated at addition of 3 ft directly in front of loudspeaker. The standard set of instruction associated with PBK 50 word list was administered. Visual as well as auditory response was used.

Table 7

Three tasks has used to determine effects of competing messages on performance. In task I child had to verbally respond to an auditory question about an item on a work sheet in front of him. Task II required non-verbal, written responses on worksheet to directions presented auditorily. Task III was to present only written stimuli to which chil/d had to respond non-verbal, written response to items on worksheet were required.

In tasks I and II child had to attend to auditory signal directdions preceeding tasks I and II were "you will be doing some worksheet, voice will be coming from four speakers around you". Directions of task III were "You will be doing some worksheet voices will be coming from speakers around you. You do not need to listen to any of the voices you will hear, don't pay attention to them.

Tasks I and II were performed under four listening conditions:

- in quiet
- 0 dB S/N ratio

- +10 dB signal to competing linguistic message ratio
- 0 dB signal to competing linguistic message ratio

Task 3-4 conditions - in quiet

- with 14 dBSPL broad band while noise
- with 64 dBSPL linguistic competing messages
- with 74 dBSPL linguistic competing messages

Table 8: Pitch discrimination

This test battery consists of 7 discriminatory tests. Each of the discriminatory tests is conducted using a constant psychophysical method with either 6 or 8 levels of the independent variable. A modified alternative forced choice presentation yielding three stimuli in all trials are presented in sets of six steps in increasing difficulty. Thihe first 6 tests in this battery use tones or tone sequence as stimuli and include 72 trials. The seventh test use CV nonsense syllable.

The standrad is a 1 kHz, 75 dBSPL, 250 msec tone. The value of the frequency increment range from 2-250 Hz, a single tone loudness. The standard is a 1 kHz, 250 msec tone at 75 dBSPL increment in level rnage from 0.5-8 dB. Single tone duration: The standard is 1 kHz 100 msec tone, increment range from 8-250 msec.

Pulse/train discrimination

Standard stimulus on this list consists of six 20 msec pulses of 1 kHz tone. These pulse tones arranged in three pairs with 80 msec between pairs. The temporal structure of sequence is varied by increasing the separation between number of lach pair from 40 msec to 90 msec. This was done to detect the changes in a repeated temporal sequence.

Embedded test tone loudness test: Subject attempt to detect difference in a sequence of tones that vary in frequency from 300-3000 Hz. This has to detect the presence of a fifth tone in a 9 tone sequence. The direction of all tones except the fifth or largest tone was 40 msec. The duration of largest tone is varied from 10-300 msec.

Temporal order for tones

The task was to discriminate the order in which two tones were presented one of which was 550 Hz, other 710 Hz. The duration of the two tones was varied from 20-200 msec. The tones presented without a gap between them and the paces of tones are preceded and followed without gaps by a leader and tailer consisting of 100 msec 625 Hz tones.

Syllable sequence test

Speech analog to test 6 in which listener discriminates the syllables /fa/, /ka/ from /ka//fa/ when

2 CV syllables are preceded and followed by the syllable /fa/, /pa/, i.e. listener has to discriminate /ta/,/fa/,/k/, /pa/ from /fa/,/ka/,/fa/;/pa/ duration vary from 75-250 msec.

Table 9

After pure tone testing, time altered sentences were presented by a tape recorder at 70 dBHL. Each sentence was presented once. The children were formalized with them. All children first heard the sentence presented at a normal rate. Remaining presentation were counter-balanced between groups for presentation rate and sentence test.

Table 10

Materials: Pure tones of frequency of 500 Hz,1000 Hz, 4000 Hz with duration of 500 msec were recorded randomly in sequence of 2,3,4,5 or 6 tones silent segments of 500 msec separated the tones in the sequence so that presentation rate was one tone/sec. There were 10 random sequences for each set of 3-6 tones.

Non-linguistic meaningful: 500 msec of 16 different recorded environment sounds randomly as above. The familiarity and recognizability of these 16 different sounds were already determined sounds were knocking, telephone, tooth brushing, water pouring, etc.

Linguistic non-meaningful: Nonsense syllable recorded at rate of 1 syll/sec by a female talker. Syllable recorded in sequence of 2 syll, 3-6 syll. Again 10 sets of each sequence were randomize. The syllables were combination of those consonants and those vowels containing features which appear to be differentiated early in phonological development. 6 consonents /p/, /b/, /ma/, /n/, /k/, /f/ presented in CV combination with one of the following five vowels /e/, /a/, /i/, /x/.

Linguistic meaningful

Common words that were meaningful, familiar and monosyllabic presented 1/sec 25 words in a sequence.

Subjects were presented with each of the 16 enviornmental sounds prior to subtest. Each child was instructed to remember the sounds but not to respond until a right signal was given. The time between end of stimulus material and signal was 5 sec. The respiration required has to produce sound in sequence.

Table 11

The P_{300} has selected using tone pips at 65 dBHL using odd ball paradign. Binaural tones were presented in a random sequence with a 2 kHz target tone occurring 20% of the time and a 1 kHz standard tone occurring 80% of time at a presentation rate of 1.1/sec with a rise and fall time of 5 msec and platead of 20 msec. Filters were set to band pass 1 Hz to 100 Hz subject were instructed to keep a mental count of the number of target tones until 300 actifact free trials were recorded. Each of the tests were administered according to the published instructions.

Electrode placement: The two inverting electrodes were placed on both mastoids. A positive non-inverting electrode was placed on the high prehead and ground electrode kept at the vertex.

Table 12

Interpersonal identification of sounds tested the child's ability to judge external auditory stimulus according to his own auditory range. Test required child to determine if a word presented orally by examiner has phonetically correct or not. A timuli picture was presented visually simultaneously with auditory stimuli. The direction were, "I will name the picture. Sometimes I will say it wrong. Tell me if I said it right". Eg. boy's picture.

Interpersonal comparator perception of sounds: Tested child's ability to discriminate betweem two similar sounds when presented by external source for this child has required to make a same/different judgement of minimal pairs which were presented orally by examiner instructed. I will say two words sometime they will be same. Sometimes not tell one if they are same or not. Eg. poy-boy.

Intrapersonal identification of sounds

Compare his verbal response with that produced auditory model to corerctly judge his own productions. Holding pictures in front of the child examiner asked "You name the picture and tell me if you said them repeat".

Intrapersonal comparator perception of sounds

Child's ability to compare his own verbal response with external source and to correct it. I will say the word two times then you say it and tell me if it sounds like mine".

Table 13

90 trials with 30 warm up trials, 30 with attention forced to left ear and 30 to right ear. The children were instructed to keep thei rhead forward and to maintain eye fixation throughout the testing on a yellow dot that was placed 60 cm in front of them on a card at eye level. A assistant sat behind this card to note oral responsefo child and to monitor eye movements. Prior to test, each child was

shown a list of CV syllables on a sheet of paper. Children were told they will hear two of these non-sense words in each ear at the same time and they would be asked to report the one they heard. Later children were instructed to report words heard in right ear to right ear respectively.

Table 14

All testing carried out in a double hailed auditory test suite. The binaural fusion test consisted of three listening conditions. In one condition (dichotic) the low pass band was delivered to the left ear and high pass band to the right ear. In the second condition (diotic) both the low and high pass band were delivered simultaneously to each ear. A third condition (dichotic 2) was the reverse of dichotic high pass band left ear, low pass band right ear.

In general testing was carried out to the procedures recommended by WIPS test. The three item pratice set from list of the WIPI procedure the first item condition. The tape recorded monitoring has done from examiner's side of test while an assistant sat next to subject and manipulated test materials subject were encouraged to respond within 5-6 intervals provided by original recording although it has possible to stop the tape with a remote control.

Masking level difference were derived by measuring marked threshold for a 500 Hz tonal and narrow band noise stimuli under a homophasic, reference condition and one antiphasic condition in binaural homophasic condition, the signal and noise were in phase in the two ears. In the binaural antiphasic condition, the tonal signal was 180° out of phase while narrow band noise was in phase. The noise was presented in phase to the two ears at a level of 60 dBSPL and subject has allowed to listen to the noise for 4-5 sec. The 500 Hz tonal signal was then presented in phase at 55 dBSPL subject had to raise his hand. MLD was defined as the difference between the threshold obtained in the homophasic to antiphasic condition.

Table 15

ABR subject was seated in a comfortable chair and three silver cup electrodes were attached using a standard electrode paste commonly used. Electrode impedence maintained at or below 3000 Oh. Click stimuli produced by applying 100/sec square noise to ear phone presented monoaurally to each ear, similarly to other ear. Tested at a rate of 1.1 clicks/sec at an intensity of 60 dB above his threshold bipolar recording made between vertex and mastoid ipsilatered to stimulation with a controlled martoid as ground. Latencies were measured from stimuli onset to vertex positive peak waves I, III, V (absolute latency) and between peak of waves I-III, III-V, I-V) (interwave latencies) for each ear.

Table 16

Dichotic recall tasks of digit strings, word tests and nonsense syllables follow a similar trend. These two digits presented to each ear simultaneously at 50 dBSPL with a total presentation of 20 pairs. The subject had to recall all digits in any order similarly carried out for words and nonsense syllables, etc. where they had to recall all words and syllables in any order.

Table 17

Tympanometry is the general term for measuring the flow of acoustic energy with an electroacoustic instrument. Achieving an air tight seal is the first step where the patient had to relax the jaw while the clinician lifts the pinna up and back with one hand and inserts the probe with other hand. Once the ear is sealed, tympanometry is performed according to the instruciton provided by the manufacturer which can be carried out manually or automatically.

Table 18

This test was a measure of cortical functioning. The test involves the use of CVC monosyllabic words which are passed through a filter which rejects the energy above 500 Hz at FdB/octave. These words were presented monoaurally and the child simply repeated the word.

Table 19

In this task speech was speeded up but with the frequency factor held constant.

Table 20

Each child received a practice trial in which they were asked to tap with one hand then to tap while reciting the names of vegetables. Dichotic listening task included presenting each child with a strip of toyboard on which 6 CV syllables were presented. Examiner pronounced each syllable with the subject repeating after him. Then he received three practice trials followed with 30 pairs of voiced CV syllables.

Table 21

For speech in noise condition, NU 6 recordings was presented through one channel of audiometer, with simultaneous noise through second channel. Attenuators of the mixer and audiometer were adjusted to produce an output of 75 dBSPL and 60 dBSPL for the words and linguistic markers and speech spectrum noise (of the secondary factors are considered (order and word list) as nuisance variables. The present investigation was a two facor design with one primary factior (marker condition) and secondary factor (word list and order of presentation).

Maskers and the lists presented simultaneously to the subjects right ear. Each subject listened to all four word lists and all four maskers. Oral response were requested in addition to written response.

Table 22

Here the sentences developed by Carrow (1981) were used because of the contrasts represented and then acceptance as a standardized test of auditory discrimination. The 30 sentences each contrast one phoneme that is critical for recognition to occur. They represent, "... sounds usually substituted or confused by children who are learning to talk or who have articulation disorders. Subset B of the carrow auditory visual abilities test contains those 30 sentences along with pictures depicting the stimuli and a training session. The children had to listen to these sentences and respond to the correct phoneme spoken by the thearapist.

Table 23

The rates included two conditions, i.e. compression and expansion wherein the stimuli was presented on the slide projector and acoustic signal generated by it started the tape recorder.

1. The first slide was presented manually
2. Acoustic signal generated to start tape recorder
3. At onset of spoken stimulus
4. Subject given time to indicate selection.

Table 24

The logic used of the CEs test is based upon a similar model of the SSW. The non-verbal stimuli used were environmental sounds.