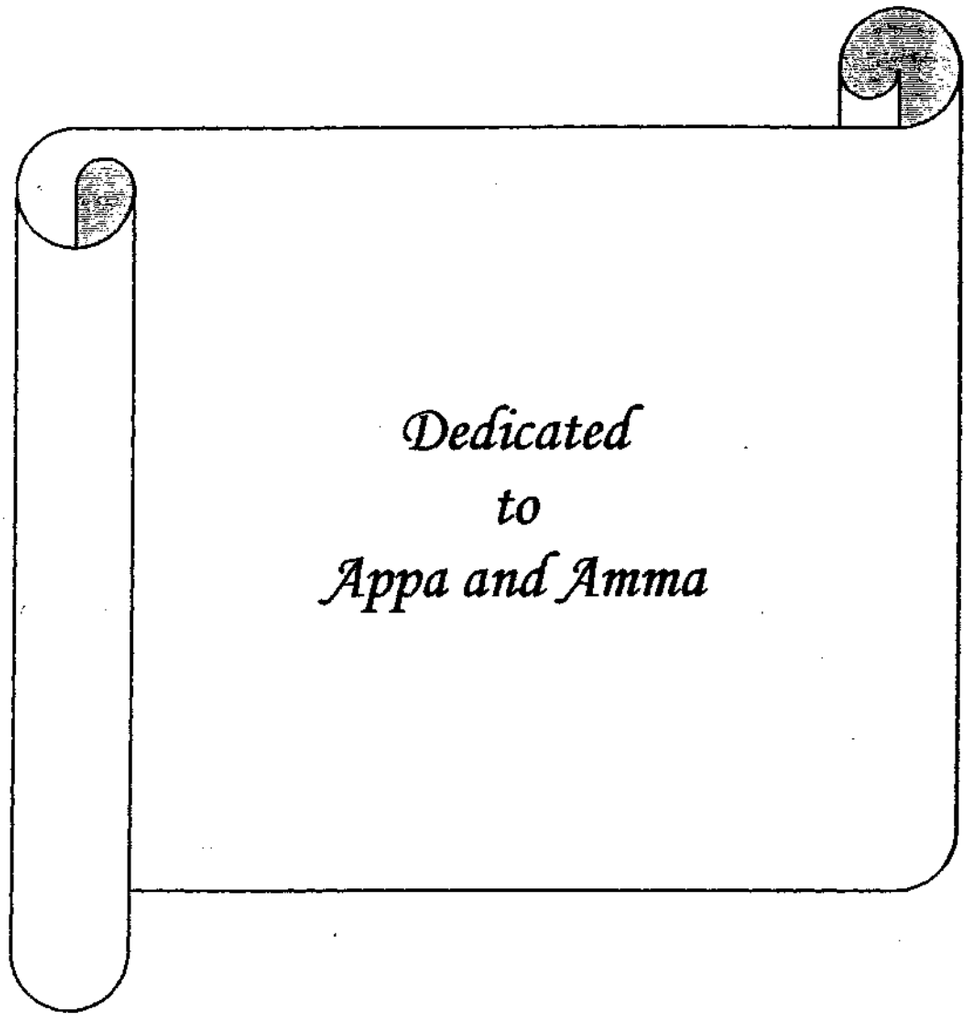
DOES AUDITORY TRAINING IMPROVE SPEECH PERCEPTION IN HEARING IMPAIRED CHILDREN ?

Register No. M9907

Independent Project submitted as part fulfillment for the First year M.Sc. (Speech and Hearing), submitted to the University of Mysore, Mysore.

All India Institute of Speech and Hearing
MYSORE-570 006.

MAY 2000


Dedicated
to
Appa and Amma

CERTIFICATE

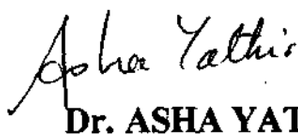
This is to certify that this Independent Project entitled "DOES AUDITORY TRAINING IMPROVE SPEECH PERCEPTION IN HEARING IMPAIRED CHILDREN ?" is the bonafide work in part fulfillment for the degree of Master of Science (Speech and Hearing) of the student with *Register No.* M9907

DIRECTOR,
All India Institute of Speech & Hearing
Mysore - 570 006

Mysore
May, 2000

C E R T I F I C A T E

This is to certify that this independent project entitled **"DOES AUDITORY TRAINING IMPROVE SPEECH PERCEPTION IN HEARING IMPAIRED CHILDREN ?"** has been prepared under my guidance and supervision.



Dr. ASHA YATHIRAJ
Reader in Audiology
All India Institute of Speech & Hearing
Mysore - 570 006

Mysore
May, 2000

DECLARATION

This Independent Project entitled "DOES AUDITORY TRAINING IMPROVE SPEECH PERCEPTION IN HEARING IMPAIRED CHILDREN ?" is the result of my own study under the guidance of Dr. ASHA YATHIRAJ, Reader in Audiology, AIISH, Mysore, and has not been submitted earlier at any University for any other diploma or degree.

Mysore
May, 2000

Register No. M9907

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INTRODUCTION

The development and use of speech as the major component of human communication is primarily dependent upon the possession of normal hearing by the individual. Normal hearing is necessary because speech signals are transmitted in the form of sound waves that can only be received by the listener via the auditory pathway. The nerve impulses that the acoustic signals trigger in the organ of hearing, travel by way of the sensory nerves to the appropriate part of nervous system. (Sanders, 1971).

It is natural for the ear to be the channel through which we learn to talk. An impairment in hearing will hinder a child's normal development of speech. This occurs since the ear serves as a guide for accurate control of the speech mechanism. Unless special training is undertaken, a child who has animpaired hearing will grow to have speech and language deficit. (Davis & Silverman, 1970).

To rehabilitate a child with hearing loss, training needs to be given to improve both speech and language abilities. Perception as well as production of speech and language needs to be worked on. One of the methods to improve the perception abilities of the child is through auditory training.

What is Auditory Training ?

The term "auditory training" is used to describe numerous teaching methods specifically designed for improving a child's auditory speech perception performance. The intent is to help the hearing-impaired child to apply his or her impaired auditory sense to the fullest capacity in language communication, regardless of the condition of the child's auditory system. Usually progress is achieved through careful application of amplification devices and through special training techniques. (Boothroyd, 1971; Goldstein 1939; Lowell & Stoner, 1960; Pollack, 1970 and Wedenberg, 1951, 1954).

Need for Auditory Training:

Auditory training is vitally important for the child whose hearing loss existed at birth or occured in infancy. Unless he has moderately good hearing in atleast one ear, his prospects of utilising sound special instruction is poor. Fortunately, even most so called 'deaf children have some residual hearing. When the remnant of hearing is small, auditory training can be used atleast as an aid in developing command of language, in instructing the child to speak and in encouraging better adjustment to the world of hearing people. The greater the residue, the more fully the child may be taught to make audition a useful tool in everyday life. Thus, to the degree that his residue hearing allows, auditory training helps the child build a firm foundation for his future adjustment in normal social situations. (Carhart, 1961).

When to Begin with Auditory Training?

As early as 1958, Whetnall referred to the first year of life as the 'readiness to listen' year. However, earlier Fry and Whetnall (1954) said that the cortical centres could readily learn to discriminate between auditory stimuli during the first three years of life.

The focus of early auditory learning and teaching of hearing impaired infants is on maximising the use of audition rather than vision. (Speech reading). This is simply because audition is the most efficient and appropriate sense modality for speech reception and for developing functional verbal communication skills. (Ling & Ling, 1978; Pollack, 1984).

When hearing loss is identified prior to 6 months & appropriate intervention services are provided by 6 months, children who are deaf and hard of hearing have the opportunity to develop language within the normal range of development during the early

childhood period. In the early identified group, no significant differences in the performances by degree of hearing loss were found. (Yashinagi-Itano, 1999a).

Early identified children prior to 6 months, with hearing loss demonstrate higher receptive and expressive language, expressive vocabulary and better personal social skills and speech skills in ealry childhood i f they receive immediate and appropriate intervention services. On average, eariy- identified children with normal cognitive skills who have received intervention are able to maintain language development within the normal range of development, iievelop intelligible speech and have personal social skills similar to those of their peers with normal hearing. (Yashinagi-Itano, 1999b).

Studies in the Speech Perception:

Early studies, by Goldstein (1936) and Forester (1928) demonstrated that auditory training given to the hearing impaired child not improve hearing thresholds but did enhance speech perception. They showed that hearing sensitivity was not influenced by auditory training, but that auditory training seemed to provide some enhancement for more complex acoustic stimuli such as speech. Perhaps what this early study was telling us was that complex tests such as speech perception required for more involvement of central mechanisms then did listening to puretones. As we now know, these central mechanisms are plastic and can be altered with practice.

In the auditory training of children or adults with peripheral hearing loss there is little hard evidence for any resulting improvement in discrimination skills. Nevertheless, there is an abundance of qualitative reports of the success of training which it would be hasty to discount. Furthermore, there is clear evidence from studies with normally hearing adults that discrimination can be improved with training. (Bamford & Saunder, 1994).

Bode and Oyer(1970) studied thirty two adults with sensorineural hearing who had given auditory training for a short period and tested for auditory discrimination. Results had shown that those who are older have got higher discrimination scores.

Failure of improvement in communication by speech after a regiman of auditory training may often due to the fact that the training was not begun early enough. It should begin in the first year of life (Silverman and Lane, 1970).

Aim of the Study:

The objective of the study was to evaluate the efficiency of auditory training in improving the speech perception of hearing impaired children.

Need for the Study:

Various researchers suggested auditory training should be given as a rehabilitative measure for the hearing-impaired to improve speech and languag e abilities. Research has shown that with auditory training, a significant improvement in phoneme recognition is possible in hearing-impaired individuals (Lieberth and Subtelny, 1978; Stone, 1983; Meyer, Swisky, Kirk and Miyamoto 1978 and Walden, Erdmen, Montgomery, Schwartz and Prosek, 1981).

Research has also shown that with auditory training, there was no significant improvement in speech perception ability (Lundberg, Risberg, Holmquist, Lingstrom & Svard, 1982).

To evaluate whether such an improvement does take place in hearing-impaired children, in an Indian set up, this study is required.

REVIEW OF LITERATURE

Auditory training has been defined differently over years. Goldstein (1939b) defined auditory training as involving the stimulation of hearing mechanism and its associated sense organs by sound vibration as applied either by voice or any sonorous instrument. It includes differentiation of pitch, rhythm, accent, volume and inflection as well as analysis and synthesis of speech sounds presented as tactile impressions.

Carhart (1961) described auditory training as a process of whereby the aurally handicapped learns to take advantage of all acoustic cues still available to him. There must first be a development of awareness of sound, then training in differentiating gross sounds from each other. Following this, there is a drill in making broad discrimination among speech sounds and finally, discrimination among sounds with highly similar acoustic characteristics.

Goldstein (1939a)and Carhart (1961) did not consider language training to be part of an auditory training activity as per their definition. However Carhart did mention above the need to teach meaningful word in his therapy approach. Other experts such as Hudgins 1954 , Pollack 1970 , Ling & Ling 1978; Pollack, 1984 considered auditory training to be a part of a language training activity.

Hudgins (1954) suggested that the possibilities of auditory training include:

a. The development of auditory speech perception.
b. Better speech, which includes greater intelligibility, more natural voices and rhythmic speech.
c. A broader and more flexible language development.
d. Acceleration of the general education program as a result of improvement communication skills.

Auditory training can be regarded as learning to attend, 'allocate cognitive resources'. The notion that auditory training can be used to improve listening skill and selective attention, is thus not forfetched, although the quantitative effects of training remain to be shown. (Bamford and Saunder, 1994).

The term 'auditory trainig' is used to describe numerous teaching methods specifically designed for improving a child's auditory speech perception performance. The intent is to help the hearing impaired child apply his or her impaired auditory sense to the fullest capacity in language communication, regardless of the condition of the child's auditory system. (Boothroyd, 1971; Goldstein, 1939; Lowell & Stoner, 1960; Pollack, 1970; Wedenberg. 1951, 1954).

The focus of early auditory learning and teaching of hearing impaired infants is on maximizing the use of audition rather than vision (Speech reading). This is simply because audition is the most efficient and appropriate sense modality for speech reception and for developing functional verbal communication skiDs. (Ling & Ling, 1978; Pollack, 1984).

Pre-Requisites to Begin Auditory Training:

a. *Early Identification of Hearing Loss:*

During first three years of life, the auditory organisation and intersensory patterning which undergird oral language are developed and the process of learning to listen occurs. By the age of the years the child with normal hearing has passed the critical periods for auditory processing and hearing learning. (Horton, 1973).

When hearing loss is identified prior to 6 months and appropriate intervention services are provided by this period, children who are hard of hearing have the opportunity to develop language within, the normal range of development during the

early childhood period. On the early identified group, no significant differences by degree of hearing loss were found. (Yoshinage - Itano, 1999a).

Early identified children (Prior to 6 months) with hearing loss demonstrate higher receptive and expressive language, expressive vocabulary and better personal - social skills and speech skills in early childhood if they receive immediate and appropriate intervention services. (Yashinage -Itano, 1999b).

Hence, it is preferable if the hearing loss is identified before the infant is six months of age. Early identification of hearing loss has also been recommended by Huizing, (1951) Wedenberg, 1954; Whetnall, 1955; Ling, 1959; Pollack, 1964; Griffiths, 1973; Beebe, 1975).

B. Use of Amplification:

(i) Binarual Hearing Aids:

The use of binaural hearing aids is known to

- Enhanced localisation.
- Summation of energy both at threshold and at supra threshold levels.
- Summation of information content especially when the hearing losses in the two ears are dissimilar in frequency distribution.
- Avoidance of head-shadow especially when listening with a background of noise.
- Better discrimination of speech in quiet and in noise.
- Ease of listening and
- Better quality of sound. (Bergman, 1957, Greon & Hellema, 1960; Mackieth & Coles, 1971).

(ii) Wide Frequency Range:

Hearing aids usually respond only frequencies from 300 to 3,000 cycles. A normal hearing range from 0 to 20,000 cycles. So when we put a hearing aid

on a deaf child, we are giving him only one fifth of the spectrum that normal hearing child uses to collect data develop the auditory process and learn to talk. Hence, Griffiths suggested that a hearing impaired child should be supplied with normal or hear-normal hearing all the time. This will make a great difference in his ability to accrue normal speech. (Griffiths, 1973).

C *Avoiding Distraction:*

Distractions that can interfere with good listening are many. The room in which the listening training is taking place can have a distracting effect. Interesting items can compete for the attention of the person in auditory training. Any stimuli that can be received by any of the sensory channels are potential competitors.

D. Motivation

The hard of hearing personmaylack sufficient motivation to become a good listener for one of many reasons. He may really believe that no amount of listening practice can achieve good results. He has a hearing loss and must suffer the handicap that attends it. One could speculate at length about factors that cause lack of motivation and the child has to be motivated to learn speech through auditory modality. (Over, 1966).

E. Signal /Noise Ratio:

The purpose of reducing the noise level in the classroom is so that the Teacher's Speech Level (singal) will be sufficien tly high to maximize the information that the students receive in the presence of background noise. The person with a severe hearing loss is extremely vulnerable to small difference here. Above all, the signal to noise (signal / noise) ratio must be +20 to +30dB for the speech to be understood by many hearing impaired children. (Mussen, 1978).

F. Intelligence:

It is important that the intelligence of the hearing-impaired child and his or her potential for developing communicate skills be evaluated competently and education goals be set realistically (Pappas. 1985)

G. Inadequate Knowledge of Results of Practice:

Insufficient knowledge of results of practice can diminish interest in learning and make the listener more vulnerable to distractions when failure occurs, the correct answer and error response should be indicated (Over, 1966).

H. Emotional Problems:

The degree to which the emotional involvement will affect auditory training depends on its nature and severity. (Oyer, 1966).

/. *Attention:*

The child has to be attentive and closely listen to the stimuli presented (Oyer, 1966)

Different Approaches:
There are several approaches that have been used for auditory training.

Carhart's Approach: (1961)
This approach of auditory training has four steps which are used while training children.

1. The development of awareness of sound
2. The development of gross discrimination
3. The development of broad discrimination among simple speech patterns
4. The development of finer discriminations for speech

1. Development of Awareness of Sound:

The first requirement in auditory training is that the child learn to know when a sound is present. He must be taught to realize that noises are meaninful. This results can be gained only by presenting sound to him. Care must be taken to guarantee that the sounds are loud enough to override his hearingloss. When he shows by his reactions that he is aware of any sound circumstances must be so arranged that this particular sound is repeated frequently. It can thus be made to serve as a wedge to introduce awareness of other sounds.

2. Development of Gross Discrimination:

The next step is teach the child that sounds differ from one another. He is trained to distinguish between highly dissimilar noise. Once the child has learned to identify highly dissimilar sounds by ear. the same procedures may be used to build finer discrimination.

3. Development of Broad Discriminations among Simple Speech Patterns:

Once the child has learned that sounds differ from one another, he is ready to start learning to understand speech. Again, training must start by teaching him to make distinctions that are easy (Vowels and Consonants).

Another approach is to start the training in speech discriminations with a few meaningful phrases. When the child has learned to recognize and respond meaninfullly to the initial group of phrases, new ones are added. The advantage of this method is that it reproduces the normal manner of learning. As the phrases become more familiar, the words begin to emerge and take on meaning.

4. Development of Finer Discriminations for Speech

The final stage of auditory training aims towards building increasingly precise discriminations, particularly for speech. The methods used depend party on the child's general maturity and partly on this past accomplishments in learning to hear effectively. Basically, however, three kinds of skill must be encouraged. First, the child needs repeated drills that encourage him to recognize the more subtle phonetic differences (s/sh and th/f). Secondly, the child must be taught to know and understand a large vocabulary of spoken woods. Finally, the child needs training in following connected speech. (Carhart, 1961).

Ling in 1978 reported that the value of using nonlinguistic stimuli in auditory training procedures for young hearing-impaired children appears limited. While responding to bells, whistle s, drums and animal sounds might be an enjoyable therapy activity for the young child, his parents and the clinician, gross non-verbal, environmental sound discrimination evidently does little to facilitate the development of speech perception skill or ultimately, to build a solid foundation for adequate aural-oral communication ability. In general, gross discrimination tasks using non speech sounds should constitute only a minor portion of a young child's auditory training program

Erber's Approach: (1982)

This adaptive method is based on a careful analysis of a child's auditory perceptual abilities through the use of the Glendonald Auditory Screening Procedure (GASP). Evaluation of child's perception skills takes into account of two major factors.

a. The complexity of the stimuli to be perceived and

b. The form of the response required. (Detection, discrimination, identification, comprehension).

The following table shows several levels of stimuli and the responses involved:

Response Task	Speech Stimulus						
		Speech Elements	Syllables	Words	Phrases	Sentences	Connected Discourses
	Detection						
	Discrimination						
	Identification						
	Comprehension						

However, the GASP evaluates only the three stimuli response combinations indicated in the Table. (Detection, identification, comprehension).

Once the child's auditory capabilities are determined, an auditory training program is outlined - taking into considerations the same model when establishing goals and beginning points for therapy. Erber proposed three styles of auditory training which differ in specificity, rigidity, and direction. These include

- ✓ The natural conversational approach
- ✓ Moderately structured approach and
- ✓ Practice on specific tasks.

Natural Conversational Approach:

1. The teacher eliminates visible cues and speaks to the child in as natural way as possible, while considering the general situational context and ongoing classroom activity.

2. The auditory speech perception tasks may be chosen from any cell in the stimuli response matrix, for example, sentence comprehension.

3. The teacher adopts to the child's responses by presenting remedial auditory tasks in a systematic manner derived from any cell in the matrix.

Moderately Structured Approach:

- The teacher applies a closed-set auditory identification task, but follows this activity with some basic speech development procedures and a related comprehension task. Thus, the method retains a degree of flexibility.

- The teacher selects the nature and content of words and sentences on the basis of recent class activities.

- A few neighbouring cells in the stimulus response matrix are involved. (For example word and sentence identification and sentence comprehension.

Practice on Specific Tasks:

- The teacher selects the set of acoustic speech stimuli and also the child's range of responses, prepares relevant materials and plans the development of the task-all according to the child's specific needs for auditory practice.

- Attention is directed to a particular listening skill, usually represented by a single cell in the stimulus response matrix. (For example, phrase discrimination).

Acoupedics: Pollack (1960).

The goals of acoupedics are to use the residual hearing of a partially deaf child to help him develop as a fully integrated personality within the world of sound and to teach him speech through the auditory senses. An acoupedic program includes early detection of hearing impairment, early fitting of hearing aids, a unisensory approach, a normal learning environment, use of an auditory feed back mechanism, the development of

language following normal patterns, recognition of the parent as the first model of communication and individualised teaching. (Niemann, 1972).

Departing from the multisensory approach, the acoupedic method avoids to lip reading. The author observed the following under this program. Vocabulary is built more rapidly then for the visually oriented child; the voice quality is more pleasing, speech patterns are normal; and the role of the parents has changed from a minor to a principle one. (Pollack, 1964)

Verbotonal Method: (Developed by **University of Zagreb).**

This method is effective for establishing good spoken language and listening skills. It is based on a developmental model of hearing children and emphasizes the importance of developing good rhythm, intonation and voice quality in hearing impaired children. Specifically trained teachers / clinicians are combined with high quality amplification and vibrotactile input with system universal verbotonal Audition Guberine Units. These units provide a wide frequency response through the cutoff frequency and slopes of filters to emphasize the optimal field of hearing of each hearing impaired child. Through intensive intervention the rhythm and intonation patterns and the listening skills develop simultaneously. The goal is to integrate hearing impaired children into regular educational and social situation. (Asp, 1985).

Eisenberg and Santore (1976) studied a case of 12 year old having congenital profound hearing loss, who received rehabilitative audio therapy according to the verbotonal method. Prior to therapy, by listening alone with the use of hearing aids, the child was unable to comprehend any speech material. Following 21/2 years of audio-therapy, he learned to make functions use of his residual hearing for the perception of speech. His aided speech discrimination scores impaired from 0% at 60dB to 56% at 60dB. The results indicate that this therapy method was very effective for this child and should be tried with similar children.

Improvement in Speech Perception with Auditory Training:

Studies carried out on normal hearing as well as hearing impaired individuals have revealed that with auditory training, an improvement in speech perception occurs.

Studies Carried out on the Normal Hearing Individuals:

The existing empirical research had indicated that young infants could discriminate both native and non-native phonetic contrasts. (Aslin, et al 1981; Lasky, Syrdal- Lasky and Klein 1975; Streater, 1976; Trehub, 1976), but the adults and children often have difficulty discriminating non-native distinctions. (Goto, 1971; Lisker & Abramson, 1970; Mackain, Best and Strange, 1981; Miyawaki, et al., 1975; Sheldon and Strange, 1982; Singh & Black, 1966; Snow & Hoefnagel - Hohle, 1978; Trehub, 1976). On the basis of this fairly consistent pattern of findings, it was hypothesized by several researchers that infants are born with the ability to discriminate the universal set of phonetic distinctions and that this universal declines or is lost, as a function of lack of specific listening experience. (Eimas, 1975; Strange and Jenkins, 1978).

In the previous experiment they compared English learning infants, aged 6-8 months, English speaking adults and Hindi speaking adults on their ability to discriminate the English and Hindi voiced bilabial versus alveolar contrast /ba/ - /da/ plus two non-English Hindi contrasts, selected to vary on their potential difficulty. (Werber, 1981). Results were, compared to the 100% of Hindi adults who could discriminate both Hindi voicing contrast and only 10% could discriminate the retroflex / dental distinction. Following a short training procedure (only 25 trials), 78% of the English-speaking adult could discriminate the Hindi voicing contrasts, but this training did not improve performance on the retroflex / dental distinction. The finding that minimal training can improve performance on atleast some non-minimal contrasts strengthened the possibility that experienced influences might not be permanent. Questions still remained as to

whether it is possible to train adults to discriminate all non-native distinctions, wheter some training methods are more effective than others and whether some non-native contrasts are untrainable.

Pisoni, Lively and Logen (1989) suggested training procedures involving labeling are more effective at facilitating linguistically relevant perception. In a sub sequent study, they found that more extensive discrimination training (500 trials) did significantly facilitate performance of atleast some English speakers on the retroflex / dental contrast. However, the effect of training had disappeared when subjects returned few weeks later. (Tees &Werker, 1984).

Studies Carried out on **Hearing Impaired:**

Lieberth and Subtelny (1978) examined that the effect of speech on auditory speech perception skills of hearing impaired young adults. The auditory perception tests were administered to two groups of subjects matched on the basis of hearing characteristics. In the experimental group, auditory phoneme identification tests were administered before and after 20 weeks period and speech training. In the control group, the same auditory tests were administered at the beginning and termination of the 20 week interval, but no speech training was provided. Statistical analysis revealed that significant gains in phoneme recognition were achieved in the experimental group. No significant improvement in phoneme recognition was achieved in the control group. These data indicate that the speech training program significantly improved auditory speech perception.

Walden, Erdmen, Montogomry, Schwartz and Prosek (1981) studied the effects of consonant recognition training on the speech recognition performance of hearing impaired adults. Two groups often subjects each received seven hours of either auditory or visual consonant recognition training, in addition to a standard two week, group

oriented, in patient aural rehabilitation program. A third group of fifteen subjects received the standard two-week program, but no supplementary individual consonant recognition training. An audiovisual sentence recognition test, as well as tests of auditory and visual consonant recognition, were administered both before and after training. Subjects in all three groups significantly increased in their audio-visual sentence recognition performance, but subjects receiving the individual consonant recognition training improved significantly more than subjects receiving only the standard two week program. A significant increase in consonant recognition performance was observed in the two groups receiving auditory or visual consonant recognition training.

Improvement in Speech Perception with Cochlear Implants:

The performance of cochlear implant users was examined longitudinally on a battery of speech perception measures and compared with subjects with profound hearing loss who used conventional hearing aids. The average performance of the multichannel cochlear implant users gradually increased over time and continued to improve even after 5 years of cochear implant use. (Miyamato, Kirk, Robbins, Todd, Riley, 1996).

Pickett and McFarland (1985) reviewed speech perception via implanted electrodes and via tactile aids. The two approaches were compared interms of amount and type of aid provided to communication. The speech perception results from multi-channel implanted subjects were better on the average, than for single channel subjects. Tactile aid performance by highly practical subjects seems comparable to that of the better implant subjects.

Kirk, Sehgal and Miyamoto (1997) compared speech perception performance in children (1) with ossified cochlear and partial insertions of the nuclear 22 channel cochlear implant. (2) with full electrode insertions the cochlear implant users with partial

versus full electrode insertions performed similarly at both the preimplanted and 1.5 year post implant evaluations. The improvement in speech perception with increased device use also were similar in the two groups. Results suggest that partial insertion of a multi channel implant is an appropriate and feasible approach to the auditory rehabilitation of children with ossified cochlea.

Berliner, Tonokawa, Dye & House (1989) evaluated the ability of profoundly deaf children using the 3M / House single channel cochlear implant to understand speech without the aid of speech reading. 51 implanted children over the age of 5 years, who had sufficient cognitive and language skills, were tested using word and sentence stimuli presented in an open set, auditory only mode. A larger proportion of children using oral communication demonstrated open set speech recognition than using total communication, showing that by training the auditory system, speech perception auditory system is better.

Subjects were tested properatively in the best aided condition and at 6 months intervals postoperetively in the implant alone condition. Due to the diversity of subjects age and language competence, the specific tests administered at each child differed. The data, acquired demonstrate significant improvements in all areas of speech perception by children wearing multichannel cochlear implants, compared with their preoperative performance with vibrotectile or hearing aids. (Staller, Dowell, Beiter, Brimacombe, 1991).

The performance of 28 chidren with the nucles multi-channel cochlear implant, who had used the device on average of 1- 7 years examined on a battery of speech perception measures. All children demonstrated better speech perception skills with the implant than they had in the preimplant condition with hearing aids. (Osberger, Miyamoto, Zimmerman, Kemink, Stroer, Firizt, Novak, 1991)

Geers and Brenner (1994) examined the changes in speech perception performance of childen with profound hearing impairment using either a nucle us 22 channel cochlear implant, tactaid tactile aid or conventional hearing aids over a 3 year period. Speech perception performance of all three groups was similar before beginning the study. After 36 months 11 of the 13 children with cochlear implants were unable to identify words on the basis of auditory consonant cues. Feature perception scores reflected an implant advantage in the perception of pitch, vowels and consonant place.

Assess ments in speech perception, speech production and language skills were conducted on two children, 5 and 10 years old at the time of surgery, using the nucle us multiple electrode cochlear implant. Data were collected pre and post operatively to measure change in performance over time. For closed set speech perception tests in audition alone condition, post operative performance was generally better than preoperative performance and performance improved for both patients. (Busby, et al, 1989).

Sixteen experienced cochlear implant patients with a wide range of speech perception abilities received the SPEAK processing strategy in the nuclear spectra -22 cochlear implant. Speech perception was assessed in quiet and noise with SPEAK and the patient's previous strategies at the study onset, as well as after using SPEAK for 6 months. After 6 months experience with SPEAK, patients showed significantly improved mean performance on a range of speech recognition measures in quiet and noise. (Parkinson et al. 1998).

Owens and Taleen (1981) evaluated the auditory perception skills of 5 subjects with profound post ingual hearing loss. 2 of the subjects were hearing aids and 3 subjects used cochlear implants. Responses of the 2 subjects with hearing aids were consistently superior to those of the subjects with implants and one of the subjects with implants consistently performed better than the other two.

The effect of different treatment program in audiological rehabilitation was evaluated. No statistically significant difference in audio visual speech perception ability was found between subjects receiving no training, subjects receiving 6 hour information codes or a 3 week intensive training in auditory and audio visual speech perception. The findings stress need for an objective tests by which to measure the effect of hearing aid fitting. (Lunbderg, Risberg, Holmquist, Lindstron & Svard, 1982).

From the review of literature, it can be noted that with auditory training, perception of auditory singles improved. This has been noted in studies that have been carried out on

a) Normal hearing individuals who were trained to perceive speech sounds that were not present in their native language and
b) Hearing impaired individuals with poor speech identification abilities. Further, studies on hearing impaired individuals have also shown that if they wore on devices that had good acoustic characteristics, they were able to perceive speech sounds better.

METHODOLOGY

In order to evaluate whether training in speech identification abilities leads to an improvement in speech perception in hearing - impaired children, the following study was undertaken.

The experiment was conducted in three stages.

Stage I consisted of a pre-test to evaluate speech identification abilities before the therapy.

Stage II consisted of auditory learning therapy, aimed at improving perception of those speech sounds the children had problems inidentifying in the pre-test.

State III consisted of a post-test that was administered to evaluate speech identification abilities after the therapy.

Subjects:

Five subjects were selected for the study based on the following criteria:

- ✓ The age range of the subjects was 5 years to 10 years.
- ✓ All the subjects were native speakers of Kannada.
- ✓ All the subjects wore hearing aids prescribed for them.
- ✓ The language level of all the subjects were above 3.5 years as per SECS (Scales of Early Communicative Skills, Moog and Geers, 1975).
- ✓ The aided speech awareness level of all the subjects was 45-50dBHL.

STAGE I:

INSTRUMENTATION:

A two channel, clinical audiometer Madsen OB822 with TDH 39 earphones housed in circumaural earcushions MX-41AR was used for testing. The calibration was done for loud speakers. (ANSI, 1989) (Appendix-I).

The children wore on their prescribed hearing aids. Three wore on binaural behind-the - ear hearing aids, while two wore on binaural body level hearing aids.

Test Environment:

The subjects were tested in a sound treated two room settings. The ambient noise level measured were found to be within permissible limits as recommended by ANSI, 1991.

Material:

The material used for pre-test and post-test was developed by Vandana, 1998. The test, "Speech Identification Test for Kannada Speaking Children" involved a multiple choice, picture pointing task. It had fifty items in all.

Procedure:

First, the aided speech awareness threshold for each of the subjects was checked. Only if they had aided speech awareness thresholds of atleast 45-50dBHL, was the rest of the tests carried out.

Of the 50 test items in the "Speech Identification Test for Kannada Speaking Children", 25 items were used. Only those words that were familiar to the child were

used. These words were selected with the help of the mother. It was ensured that the word selected included all the phonemes of the language.

Administration of Speech Identification Test:

Two examiners carried out the speech test. One examiner presented the stimuli using monitered live voice in the control room. It was ensured that the vumeter of the audiometer deflected to zero. A distance of 6 inches was maintained between the mike and mouth of the speaker as recommended by Penrod (1994). The other examiner in the patient room was seated beside the child to help him/her to turn the appropriate page of the picture response book. The stimuli were presented at 60 dBHL for each subject. The child was seated at a distance of one meter at an angle of 45° with reference to the speaker. The children wore on their prescribed hearing aids. Three subjects wore on behind the ear hearing aid and two subjects wore on body level hearing aids. All the subjects were tested with binaural hearing aids.

The subjects were given instructions in Kannada in the following way:

"You will hear some words. Listen carefully to each word and look at all the pictures on the page. Point to the picture of the word that you hear". The activity was demonstrated on the practice items prior to carrying out the test.

Scoring:

The responses of the children was in the scoring sheet (Appendix-II). For every correct response, a score of four was given and for every incorrect response, a score of zero was given. The percentage of the scores was calculated.

STAGE II

MATERIAL:

Based on the responses of the children on the pre-test, the therapy material was constructed. The speech sounds which the subjects misperceived were noted. Word lists were formed using those speech sounds in the initial, medial and final position. These words were used for the training. The words taken for the training were entirely different from the test material. The list contains 15 monosyllables and 25 bisyllables words.

Therapy Procedure:

The subjects attended therapy individually for fifteen sessions. Each session was for a duration of 30 minutes. Intensive therapy was given using the misperceived speech sounds in the initial, medial and final positions. The therapy was initially given for those speech sounds which the children had less difficulty. Less difficult words were those which the subjects could perceive atleast once or twice correctly during the pre-test. The ones that the children had more difficulty were dealt with later.

First, two subjects were taught the name of the pictures. The subjects were instructed to pointout to the respective picture whenever the therapist said it. The stimuli were given with auditory, visual and tactile cues. If the child was able to point out to the picture with all these cues, then only auditory cues were given. The stimuli were given three times. Out of three trials he has to point out atleast twice. Only, then did the therapist move onto the next word. The therapy was given on alternate days for a duration of one month. The parents were instructed to carryout the therapy at home also. The children wore on their prescibed hearing aids during and after the therapy sessions.

STAGE HI:

After fifteen sessions of training, the picture identification test was administered again on each subjects at 60 dBHL. The procedure and scoring was done as mentioned in stage I. However, the order of presentation of the test items was altered.

The scores obtained in Stage and Stage III were subjected to statistical analysis.

RESULTS AND DISCUSSION

In order to evaluate improvement in speech identification abilities in hearing-impaired children, after intensive auditory training, five hearing impaired children were studied. Prior and after the auditory training therapy, their speech identification abilities were evaluated using the "Speech Identification Test for Kannada Speaking Children (Vandana, 1998). The pretest and post test scores obtained by the subjects is shown in Table-1.

Table — 1. Pre-therapy and Post-therapy. Speech Identification Scores of the Hearing Impaired Children.

Age/sex	Pre test scores	Post test scores	%of improvement	Degree of hearing loss	Hearing aid
5 years/M	4-6%	64%	24%	Profound	Body level
5 years/F	48%	64%-	16%	Severe	BTE
5 1/2 years/M	64%	84%	20%	Profound	BTE
6years/M	44%	56%	12%	Severe	Body level
10 years/F	36%	80%	44%	Profound	BTE

Statistical analysis was done using non-parametric t-test. The results showed that there is a statistically significant improvement in the performance of speech identification ability ($P<0.001$, Garrett. 1966). This indicates that with just fifteen sessions of intensive auditory training therapy, speech identification ability of the children improved.

An examination of the raw data reveals that the improvement in speech identification ranged from 12% to 44%. The two subjects who had severe hearing loss showed lesser improvement, while those with profound hearing loss showed more improvement. It is possible that the children with severe hearing loss were probably already using their residual hearing to perceive most of the segmental cues used for the

perception of speech sounds. Thus, with therapy there was less improvement however, the children with profound hearing loss learnt to perceive these cues better with therapy and hence the greater improvement in the post-test scores.

Following training,the speech sounds in which they had less difficulty in the pre-therapy test, were consistently perceived correctly. However, the speech sounds which they had considerable difficulties perceiving in the pre-therapy test, were perceived inconsistently after therapy. It needs to be investigated as to whether more intensive therapy for the latter group of sounds would help the subjects perceive than better.

Only one subject showed a large improvement of 44% for the remaining subjects the improvement ranged from 12% to 24% (table-1). This large improvement could be attributed to two reasons. The higher improvement could be because she was older than the other children by 4 to 5 years. The maturity may have helped her perceive segmental cues better after therapy. More likely, the improvement was seen because she was not using her residual hearing to the maximum prior to therapy. She obtained the least scores in the pre-therapy speech identification test. With therapy, she learnt to use her residual hearing to a much greater extent.

There were many studies supporting the present study. The study done by Lieberth & Subtelney (1978) examined the effect of speech training on auditory speech perception skills of hearing-impaired young adults. The results revealed that significant gains in phoneme recognition in the experimental group and no significant improvement in phoneme recognition was achieved in the control group. These data indicate that the speech training program significantly improved auditory speech perception.

Walden, Erdmen, Montgomery, Schwartz and Prosek (1981) studied the effects of consonant recognition training on the speech recognition performance of the hearing impaired adults. The results revealed a significant increase in consonant recognition

performance in the two groups receiving auditory or visual consonant recognition training.

Similar results were obtained by Bode & Oyer (1970).

Lundberg et al.(1982), however, contradict the findings. They did not report of an improvement in speech perception with auditory training.

From the findings of the present study it can be inferred that intensive auditory training results in an improvement in speech identification abilities in severe and profound hearing-impaired children.

SUMMARY AND CONCLUSION

It is natural for the ear to be the channel through which we learn to talk. An impairment in hearing will hinder a child's normal development of speech. Unless special training is undertaken, a child who is born with impaired hearing will grow to have speech and language deficit. (Davis & Silverman, 1970).

In order to evaluate whether auditory training improves speech perception, this study was taken up. Five hearing-impaired children with severe to profound hearing loss were evaluated prior to and after the auditory training therapy. They were evaluated for their speech identification abilities using "Speech Identification Test for Kannada Speaking Children" (Vandana, 1998). Fifteen sessions of intensive auditory training therapy was given to each child for the speech sounds in which they had difficulty perceiving in the pre-test. After the training, speech identification abilities were tested again.

The percentage of improvement in speech identification ranged from 12% to 44%. The two subjects who had severe hearing loss showed lesser improvements while those with profound hearing loss showed more improvement. The speech sounds, in which they had less difficulty in the pre-therapy test, were consistently perceived correctly and the speech sounds which they had considerable difficulty were perceived inconsistently after therapy.

From the findings of the present study, it can be concluded that intensive auditory training results in an improvement in speech identification abilities in severe and profound hearing impaired children.

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APPENDIX I

Loud Speaker Output Level Calibration Procedure:

1. Set the controls on the audiometer to free field testing operation.

2. Place the SPL meter at the height of ear level and its microphone should be at the center of the subjects head position which will be during testing. Position, subjects position distances should be at least 1 meter away from the face of loudspeaker. Make use of the floor stand supplied with SL meter.

3. Present the white noise through loudspeaker at 80dBHL. (Preferably speech spectram noise is used. It is a white noise with equal. Erergy from 250 to l000Hz and a 12dB/octave. Fall off from the l000Hz to 6000Hz). The output from the audiometer to loudspeaker should be monitored to zero on the VU meter.

4. Set the SL meter to linear scale and take the readings the output level should 93dBSPL (80 ÷ 13).

5. Check the attenuator linearchy of the loudspeaker by following procedure.

6. Set the attenuator to the maximum hearing level and note down the output level.

7. Decrease the hearing level in 15dB steps till the minimum hearing level. Each time the intensity is attenuated note down the output levels accurately.

There should be a corresponding decrease in output levels. As the attenuator is decreased in output levels, as the attenuator is decreased by 5dB steps or according to the ANSI standards the attenuator should be linear with 0.3 of the interval step. (or 1.5) dB which ever is smaller). That means when the dial is decreased by 5dB it must attenuate between 3.5 and 6.5 dB.

APPENDIX-II

SCORE SHEET

Name: **Age/ Sex:** **Date:**

Audiological Findings:

500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz

Key: Correct Response

Incorrect Response

List-A	**List-B**
Level————dB (w.r.t. FA)	Level————dB (w.r.tFA)
Correct %————————————————————	Correct %————————
/lo:ta/	/kannu/
/e:ni/	/hu:vu/
/cha:ku/	/ka:ge/
/bassu/	/kappe/
fga.be/	/mola/
/karru/	/e:ni/

/la:ri/		/male/
/mane/		/lo:ta/
/nalli/	-	/da:ra/
/me:ke/		/cha:ku/
/mola/		/mane/
/ka:ge/		/nalli/
/se:bu/		/o:le/
/bi:ga/		/bassu/
/ko:li/		/kattu/
/hu:vu/		/gu:be/
/mu:gu/		/chatri/
/hasu/		/me:ke/
/male/		/se:bu/
/kappe/		/bi:ga/
/kannu/		/la:ri/
/da:ra/		/mu.gu/
/chatri/		/ka:ge/
/chi:la/		/gini/
/mi:nu/		/tatte/
/me:ju/		/sara/
/ili/		/ka:ru/
/su:ji/		/pennu/
/tale/		/ni:ru/

/kivi/

/pennu/

/mara/

/bale/

/ka:lu/

/gante/

/sara/

/chendu/

/railu/

/ka:ru/

/o:le/ .

/a:ne/

/tatte/

/gini/

/ha:vu/

/na:yi/

/hallu/

/ka:su/

/su:rya/

/ni:ru/

/ele/

/bale/

/a:ne/

/chendu/

/hallu/

/mara/

/m:nu/

/na:yi/

/ko:li/

/kivi/

/ili/

/surya/

/ka:su/

/ka:lu/

/ele/

/chi:la/

/me:ju/

/su:ji/

/gante/

/railu/

/tale/

/ha:vu/