

PRODUCTION OF STRESS IN HEARING IMPAIRED CHILDREN

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Register No. M-9121

A DISSERTATION SUBMITTED IN PART FULFILMENT FOR FINAL M.SC.
(SPEECH & HEARING) TO THE UNIVERSITY OF MYSORE, MYSORE.

ALL INDIA INSTITUTE OF SPEECH AND HEARING
MYSORE-570 006


1993

To
my guide Dr.S.R.Savithri
for her
proficient help and motivation
AND
Mummy & Daddy
Anna, akka & mama
Niece, Sweet Sandhana Kutty,
others who sincerely well wished for me.

CERTIFICATE

This is to certify that this Dissertation entitled "Production of Stress in hearing impaired children" is the bonafide work done in part fulfilment for Final Year M.Sc., (Speech and Hearing) of the student with Register No.M.9121.

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1993


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CERTIFICATE

This is to certify that this Dissertation entitled "Production of stress in hearing-impaired children" has been prepared under my supervision and guidance.

Mysore
1993


Dr. S.R. Savithri
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DECLARATION

This dissertation entitled "Production of stress in hearing impaired children" is the result of my own study undertaken under the guidance of Dr.S.r.Savithri, Lecturer in Speech Science, All India Institute of Speech and Hearing, Mysore and has not been submitted earlier at any university for any other diploma or degree.

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Register:No.M.9121

ACKNOWLEDGEMENTS

Thanks are due to Dr.(Miss)S.Nikam, Director, All India Institute of Speech & Hearing, Mysore for giving permission to carry out the study.

I am very thankful to Dr.S.R.Savithri, Lecturer, Department of Speech Sciences, All India Institute of Speech & Hearing, Mysore for all her encouragement, splendid help, invaluable suggestions and ideas and above all to have put up with me patiently. A Billion thanks to you, mam.

She 44 -the one, because of whom, my interest in speech pathology was doubled and I would always remain thankful to her, for her constant encouragement and concern she showed in everything I did. Thank you, MANJULA MAM.

Thanks to Dr.VIDYASAGAR, to have given us a strong foundation in research methodology.

I am very grateful to Mr.Nakeertan, Research Scholar at CITL, and Mr.Ravishankar, Lecturer at Surat University, whose contribution was of invaluable help to me.

I am very grateful to Mr.Selvan and Mrs.Arthur, the Head Master and Head Mistress of the Government Schools at Ooty and Tanjore, for their kind cooperation during my data collection.

RAJI : I just wonder, how to construe my gratitude. Twelve whole years of friendship, I can never forget. Whenever and whatever I do, there is always some of your influence which I always like.

Raji, I would always remain indebted to you for all that you have said and did for me.

Thanks to:-

Thiyagu :-to have been there at Ooty when I needed your help. I really wonder if anyone can be so considerate and helpful like you. Thanks to your alacrity.

Manohar:- fo the efforts you had put in learning the A,B,C,D's of speech and hearing, in order to help me during my collection of data at Tanjore.

Susi :- Though being far-off, to have been always concerned about me and my work.

Stella :- To have shared all my joyful and sorrowful days at AIISH.

Sajee :- my sweet sister, for all that she has done for me.

Buvana,S & Rains:- to have been the judges of my study and to have helped me sincerely without making any facial grievances, inspite of me, wasting their valuable time.

Prema :- for her constant enquiries and kind concern.

J :- for her help during the analysis of my data.

Pathakji :- to have listened and answered patiently all od my bugging questions during our postings.

Sachi :- for her ever-readiness to help.

Javer, Sanyo, Pitu, Patro & Balaraju - to have been new but reliable friends.

I can never forget those children, who actively participated in my study. Thanks to those sweet little angels to have made me realize, as a professional how helpful, I can be to them.

I thought of acknowledging my family members, but it would be like thanking myself.

Thanks to Mr.Sridhar, R.K. for his neat work and to have given my dissertation a magnificent look.

Thanks to the Library Staff, AIISH, to have been always there, to help us.

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INTRODUCTION

"And his ears were opened, his tongue was released and he spoke plainly. And he charged them to tell no one but the more he charged them, the more zealous they proclaimed it. And they were astonished beyond measure Saying, He has done all things well, he even makes the deaf hear and the dumb speak"

(New testament Mark 7:35-37)

Suprasegmentals or prosodic features are those whose domain extends over more than one segment. Suprasegmental features relate to segmental features by constituting an overlaid function of the inherent features. These features include intonation, rhythm, stress and juncture (pause). A substantial proportion of the research has been directed to the study of stress.

Sweet (1878) says "Stress is the comparative force with which the separate syllables of a sound group are pronounced" According to Abercombie (1923) "Stress is force of breathe impulse". Classe (1936) opines that "Stress is an impulse (primarily of a psychological nature) which expresses itself in the first place by an increase of pressure in the speech mechanism and approximately coincides with the point of greatest pressure". Stress can be defined in terms of greater effort that enters into the production of a stressed syllable as compared to unstressed syllable (Lehiste,1970).

The production of stress has been studied among the clinical groups and it has been found that stress is adversely affected among apraxics (Gelfer,1980), stutterers (Wingate,1985), aphasic and autistic children (Baltaxe,1984), learning disabled students (Highnam et al,1987), language impaired children (Hangrove et al,1989) and in the hearing impaired population (Angelocci 1962, John & Howarth 1965, Boone 1966, Boothroyd et al 1974, Levitt et al 1974, Nickerson 1975, McGarr et al 1978, Graddol 1991).

In all the studies on the speech production of the hearing impaired, attention has been drawn to the fact that, to a greater or lesser degree, the deaf do not produce speech as well as those who hear. This fact surprises no one, as normal speech production requires the auditory perception and monitoring of speech (Monsen,1978). It has been opined that speech intelligibility of the hearing impaired is affected by the interaction of segmental and suprasegmental aspects of speech (Parkburst et al 1978, Metz 1980).

Errors involving individual speech phonemes i.e. segmental errors, have been studied in depth, by a number of researchers (Hudgins & Numbers 1942, Nober 1967, Markides 1970, Smith 1972, 1975a, Monsen 1977, Shukla 1987). The results of these studies indicate that, in statistical term there is a high negative correlation between the frequency of segmental errors and intelligibility i.e. the higher the incidence of segmental errors, the poorer the intelligibility of the speech, on the average(Smith 1972).

A relatively small amount of quantitative data is available on the effect that suprasegmental errors have on intelligibility (McGarr et al,1978). It has been found that children with approximately the same frequency of segmental errors had speech intelligibility scores differing by as much as 30% (Levitt et al,1974). Errors such as intermittent phonation, spasmodic variation in pitch and loudness and excessive variability of loudness correlated with differences in intelligibility (McGarr et al,1978).

Other aspects of poor phonatory control present in deaf speech may include excessively high fundamental frequency (Green 1956, Angelocci et al 1964, Martony 1968) and less than normal variation in fundamental frequency resulting in flat and monotonous sounding speech (Voelker 1938, Green 1956, Hood 1966, Smith 1972).

Prosodic features, such as stress and intonation, may be conveyed in part by changes in pitch and intensity. Several investigators (Stark et al 1974, Gold 1975, McGarr 1976) have shown that the hard-of-hearing children have difficulty in producing such features as stress, pausal juncture and intonation.

The studies on stress, indicate that the hearing impaired children are very poor in the production of stress. It has been found that the hearing-impaired children do not sufficiently vary the differences in durations of unstressed and stressed

syllables (Angelocci 1962, Nickerson 1974). Boone (1966) opines that it looks as if the hard-of-hearing produce only stressed syllables. Levitt et al (1974) comment that the hard-of-hearing speakers produce the temporal feature of pause better than stress.

The most common error type, in the prosodic feature production task, is the production of the sentence with equal stress followed by equal pause for each syllable i.e. staccato (McGarr et al,1978). When acoustic analysis of stress contrasts produced by hearing-impaired children was performed, it was found that the syllables that the subjects intended to stress were perceived by the listeners as stressed (Murphy et al,1990). This is a very rare finding. Also, research indicates that the hearing-impaired speakers are less accurate in lexical and metrical destressing (Graddol,1991).

The studies on the reception of stress shows that they perform poorly on such tasks as they find much difficulty in perceiving the differences in frequency and intensity.(Smith 1973, Stark et al,1974).

All these studies indicate that though there are variations within the group on the type of error noted, overall as a group, the hard-of-hearing perform poorly on tasks involving production or reception of stress. However, it is not clear how stress is produced by the hearing impaired. In this context, the present study is planned.

The aim of this study is to understand the production of stress in the Tamil* speaking hearing-impaired children with language age of 2-8 years.

* Tamil is a Dravidian language spoken by millions of people in Indian subcontinent (Hockett,1976) and 85% of the population in Tamilnadu (Vasantha Kumari,1989).

REVIEW OF LITERATURE

Hearing impairment has a marked effect on a child's ability to acquire speech. As this effect is related to the extent and type of hearing loss, thus the child who is hearing-impaired is most likely to have difficulty in both understanding speech and producing speech that is intelligible.

In a normal hearing person's speech, the speech signal is structured at the suprasegmental level by features that serve to organize sequences of syllables into words and phrases. One suprasegmental characteristic lexical stress, seems to be an important cue to word identification (Gaitenby et al.1977). Studies of hearing speakers have established the importance of three acoustic cues (vowel duration, amplitude and fundamental frequency) in conveying lexical stress.

With respect to hearing impaired persons, there have been numerous studies of segmental and suprasegmental production. (Osberger et al,1982). Errors involving individual speech phonemes i.e. segmental errors, has been studied in depth by a number of researchers (Hudgins & Numbers,1942; Nober,1967; Markides,1970; Smith,1972,1975a; Monsen,1977; Shukla,1987).

However, a relatively small amount of quantitative data is available on the effect that suprasegmental errors have on intelligibility. It has been found that children with approximately the same frequency of segmental errors had speech intelligibility scores differing by as much as 30%.

Although the prosody of the hearing impaired speech has not been extensively studied, there have been enough investigations to establish some measure of agreement about its major features. Graddol (1991) has listed these features under the following heads:

- 1) Voicing control
- 2) Pitch control
- 3) Pitch range and level
- 4) Monotony
- 5) Syllable stress
- 6) Vowel length
- 7) Pauses

As stress is the focus of this study, the review will be pertaining only to stress. Almost all of these studies are regarding the production aspect and studies regarding reception of prosodic aspects are rare.

The studies, on suprasegmental production by the hearing impaired, are often descriptive in nature. Speech produced by persons with severe to profound hearing loss, has been described as "Staccato like" suggesting a failure to differentiate stressed and unstressed syllables. Another common description is "Flat and devoid of melody" suggesting a failure to vary F_0 . As duration intensity and fundamental frequency are the major cues for stress, when these are not varied appropriately, the production of stress is also affected. Table-1 shows the summary of stress variations in the hard-of-hearing.

Production	Reception
The durations of the unstressed vowels were longer.(Angelucci, 1962)	The hearing-impaired children could identify purely temporal differences with greatest ease
A stressed syllable in final position is likely to be 3-5 times, as long as a preceding unstressed syllable. For deaf speakers the ratio is typically smaller than this.(John & Howarth,1965)	Differences in frequency and in intensity were more difficult for the children. (Smith,1973).
The deaf speakers produce only stressed syllables (Boone,1966)	On a "Same" or "Different" tasks, the hearing impaired child did less well in detecting changes in stress. (Stark & Levitt,1974).
The unstressed syllables in the deaf were twice longer than normals (Boothroyd et al 1974).	
The deaf children produced the temporal feature of pause better than stress. (Levitt & Stark,1974).	
Failure to make sufficient difference in the durations of stressed & unstressed syllables (Nickerson,1974)	
The stressed syllables produced by hearing impaired speakers were usually accompanied by an F0 change (Nickerson,1975).	

contd.

In the hearing-impaired production of stress is poor. The most common error type was production of the sentence with equal stress followed by equal pause for each syllable (Staccate) (McGarr & Osberger 1978).

When hearing impaired subjects correctly produced stressed syllables, they did so with increased amplitude, duration and fundamental frequency. When they did not, no acoustic feature (or combination of features) accounted for their errors. (Murphy et al 1990).

TABLE I: Stress in the hearing impaired.

It has been found that, the hearing impaired children do not make sufficient difference between the stressed and unstressed syllable. They prolong the durations of both stressed and unstressed syllables, the increase trends to be proportionally greater for the unstressed sounds (Angelocci,1962). The hearing impaired speakers fail to make the difference between the durations of stressed and unstressed syllable sufficiently large (Nickerson et al,1974)

It has been found that the ratio between the stressed syllable and a preceding unstressed syllable is typically less,

in the hearing-impaired population. Speakers with normal hearing lengthen stressed syllables and syllables in word final and sentence final positions (Parmenter & Trevino,1935; Fry,1958, Klatt,1974; Lindblom & Rapp,1973). A stressed syllable in final position is likely to be 3-5 times, as long as a preceding unstressed syllable, for the hearing impaired speakers, the ratio is typically much smaller than this (John & Howarth,1965).

It is almost as though the deaf speakers produces only stressed syllables and in fact investigators have suggested that this problem, is, in part a result of training that puts great emphasis on the articulation of individual speech sounds in isolation or in isolated consonant vowel syllables (Boone,1966).

The hearing impaired speakers tend to increase the duration of the unstressed syllables. They produce unstressed syllables twice longer than the normals (Boothroyd et al 1974).

The hearing impaired children produced the temporal feature of pause better than stress. The deaf children were asked to produce, six sentences using two forms of stress (early and late), pause (early & late) and question. These sentence types were presented to the children in written form. The children's attempts to produce the sentences were tape-recorded. At least two independent listeners then judged whether or not the child had produced the required sentence form correctly. The children were found to be able to produce the temporal feature of pause best. Stress was less easy for them although they were better able to produce this feature at the end of a sentence than at the

beginning. The judgement of staccato was made 27 percent of the time (Levitt & Stark,1974).

Though, there are equivocal studies, regarding clues for stress, it has been found that the stressed syllables produced by hearing impaired speakers were usually accompanied by an F₀ change (Nickerson,1975). When contrasting stress, intonation, and juncture or pause were tested, the hearing impaired tended to perform poorly in the production of stress. The speech production of 57, 11 to 12 year old deaf children was analyzed. The study included 25 females and 32 males. A test of prosodic feature production was developed in order to examine production of three prosodic features of English. A speaker recorded sentences with contrasting stress, intonation and juncture or pause. Extreme examples of each (in terms of acoustic cues) were chosen. Six sentences were constructed for each variable. The feature of stress was indicated by underlining and capitalization. Each child practised several nontest items in order to familiarize himself with the written clues for stress, pause and intonation. When it was felt that the child understood the concept, he was asked to read the sentences and his utterances were recorded. Raters experienced in listening to the speech of the hearing impaired evaluated the recordings. The listeners were asked to indicate whether the intended feature was correct, and if not, what error was made. Their choice of error types consisted of pause in the wrong location, stress in the wrong location, inappropriate intonation, staccato (equal stress and equal pause on all syllables) or unintelligible utterance.

It was found that the children did less well on production of stress. The children seemed to be slightly better in producing a stressed form that occurred near the end of a sentence than one that occurred near the beginning. The most common error type was production of the sentence with equal stress followed by equal pause for each syllable (i.e. Staccato) (Mc Garr and Osberger,1978).

When acoustic analysis of stress contrasts produced by the hearing impaired children was performed, it was found that the syllables, the subjects intended to stress were perceived by the listeners as stressed. In this study, there were two groups, speakers and listeners. The speakers were seven females and six males ranging in age from 9 to 19 years (mean age of 13.9 years) with congenital profound hearing loss. Each subject produced three nominally spondiac words:- cupcake, bath tub and hot dog:- 10 times each, systematically alternating primary lexical stress between the first and the second syllable. Perceptual test and acoustic analysis (vowel duration, peak Fo and peak amplitude) was carried out. It was found that when these subjects correctly produced stressed syllables, they did so with increased amplitude, duration and fundamental frequency. When they did not, no acoustic feature (on combination of features) accounted for their errors. The data also suggested that there were important between speaker differences in the overall hierarchy of cues adopted to convey lexical stress (Murphy et al,1990). It has been found that lexical destressing and metrical destressing are less accurate in the hearing impaired children. Graddol

(1991) says that the claim that deaf speakers tend to produce too many stressed syllables is borne out by an analysis of his subject, an eight year old hearing impaired boy, Stefan's between lexical stress and the rhythmic destressing of items in certain word classes in order to provide the approximately isochronous feet which is characteristic of English. His accuracy on lexical destressing was 62 percent, as opposed to very nearly 100 percent by the hearing children. Metrical destressing is less accurate in both Stefan and the children with normal hearing (Stefan = 48, other normal hearing children = 70).

All of these studies indicate that the production of stress among the hearing impaired children is severely affected and it has been indicated that among the suprasegmental features like intonation, pause, juncture and stress, stress is less accurately produced.

Attempts have been, also made to assess the prosodic feature reception in older hearing impaired children. It has been found that the hearing impaired children, could manage the temporal differences easily compared to differences in frequency and in intensity. The first attempt was made by Smith (1973) in what she refers to a speech approximation test. The investigator presented sequences of nonspeech (puretone) signals differing in duration, frequency, intensity and rate of presentation. She also included short tape-recorded sentences, filtered at 500Hz, that differed in intonation (pitch contour, duration, position of

stress and phrasing i.e. position within the sentence of a pause). The children responded by pointing to stimulus cards on which the sentences were printed, or pure tone sequences were displayed graphically. The children found those pure tone sequences that differed in duration and rate of presentation to be easiest to identify. Thus, purely temporal differences could be managed with greatest ease. Differences in frequency and in intensity were more difficult for the children, especially the intensity differences .

This study has been supported by further investigations (Stark & Levitt,1974). They presented a stimuli which was a sentence with added stress (I can run, I can run, I can run). The children were asked to make a judgement of "same" or "different". The children did less well in detecting changes in stress. The authors concluded that this is because stress differences involved intensity, frequency as well as durational clues, which were the hardest for the children to deal with.

Summarizing all these studies, it can be said that stress production as well as reception is adversely affected in the hearing-impaired population and there is lot of variations within the group regarding the type of error. However, still more needs to be worked in this area. In this context, the present study is conducted to evaluate the production of stress among the hearing impaired children speaking Tamil.

METHODOLOGY

Material:

Audio recorded samples of ten words (9+1 repeated), 10 phrases (9+1 repeated) and 10 sentences (9+1 repeated) were used as material. This was selected from the original list developed by Jaya(1992), for her study on the development of stress in Tamil speaking children. The material were as follows:

2-4 years: 10 meaningful bisyllabic Tamil words were selected. The words were of CVCV combination where the consonant was same in both syllables of the words and the vowel varied. Stress was assigned to one of the syllables of the word randomly.

4-6 years: 10 phrases were selected, which had a mean length of utterance of two words. The phrases were selected such that varied grammatical categories such as Noun + Noun, Noun + Noun, Noun + Verb, Noun + Verb, Adverb + Verb, Adverb + Verb, Adjective + Noun, Adjective + Noun (/ superscribed indicates stress) were represented.

6-8 years: 10 sentences with a mean length of utterance of three words were selected. The grammatical categories chosen were Noun + Adverb + Verb, Noun + Noun + Verb, Adjective + Noun + Verb. Stress was assigned to any one of the grammatical categories chosen. Stress was represented in all the three positions equally, among the sentences selected. All the selected words, phrases and sentences as uttered by a female speakers were recorded in an audio cassette which formed the material.

Subjects:

The study included 30 hearing impaired subjects, ten each in the language age (5 males + 5 females) of 2-4, 4-6, 6-8 years. For determining the language age of these children, Receptive Expressive Emergent Language Scale (REEL) and the Extended REEL (not yet standardised for the hearing impaired population) was used, due to the nonavailability of any such test for determining the language skills in hearing impaired children.

All the children selected had: a) Congenital hearing loss, b) moderate to severe degree of hearing loss c) knowledge of Tamil and d) normal oral structures. They all could read and follow instructions.

These subjects were selected from two Government Schools for the deaf, one located at Ooty and the other at Tanjore. All the subjects used hearing aids (under Government scheme) and oral communication method was followed for instruction routinely in these schools. All these children were from middle socio-economic class, as reported by the school authorities.

Method: The recorded material was audio presented from a tape recorder to the children, one at a time in a quiet room. Along with this, simultaneously the written forms (1" x 1" card) with the word to which stress is assigned being underlined was also presented as these children were partially dependent on speech reading and were finding difficulty in perceiving the recorded material. They were instructed to listen to it carefully and

also to supplement their perception, by referring to the written forms and imitate the words/phrases/sentences. Those hearing impaired children with language age of 2-4 years were presented with bisyllabic words, 4-6 years with two-word phrases and 6-8 year children with three-word sentences. These children were given a trial before the experiment. They were allowed to listen to the model as many times as they liked. Special efforts were not made to make the child aware of the stressed word. The responses of the children were audio recorded.

Analysis: The recorded samples of the imitations were given to two judges for perceptual judgement. The judges selected were post-graduate students in speech pathology and Audiology in the age range of 22-24 years. The judges were instructed to listen to the model and the imitation and to mark it as "S" if the intended word was stressed, "D" if the imitation did not match the model for stress, "AS", if it was Staccato and "NS", if no stress was produced. Also, they were to give details of what they meant by different.

The total number of "S", "D", "AS", "NS" were calculated for each child and the percent "S", "D", "AS" & "NS" was computed by using the formula

$$\frac{\text{Total "S"/D/AS/NS}}{\text{Total No. of Words/Phrases/Sentences}} \times 100$$

A rank correlation was performed to test the interjudge reliability and "T" test was carried out to find out the significance of difference between the means of various age groups and also between males and females.

Apart from this, the position of the stress assignment and the grammatical unit were also analysed to find out the role of linguistic factors on stress.

RESULTS AND DISCUSSION

The results reveal that the scores on "Same" increases with age which implies that the performance of the hearing impaired children's imitation of stress improved from 2-8 years. Although as a group, the hearing impaired children performed poorly, the peak scores for "Same" were obtained at 4-6 years which indicates that this language age group performed better than the other two groups. The percent scores for "All stressed" decreases with age which implies that the hearing-impaired children are in the stage of learning to produce stress. Though AS decreases with age, NS is maintained which indicates that the hearing impaired children are not able to make differences between the stressed and unstressed syllables even with increasing age.

TABLE-II shows the mean percent scores as obtained by the hearing impaired children.

Age in Language years	Percent scores for same		Percent scores for different		Percent scores for all std.		Percent scores for NO	
	J1	J2	J1	J2	J1	J2	J1	J2
2 - 4	27	23	35	19	36	27	2	31
4 - 6	43	58	38	18	15	13	4	11
6 - 8	38	42	49	30	4	15	9	13

TABLE-II: Percent scores for stress production.

On an average, the hearing-impaired children imitated the stress pattern correctly 38.5% of the time, produced "different" stress patterns 31.5% of the time, stressed all the syllables/words/phrases 18.33% of the time and produced no stress 11.66% of the time. While the pattern of stressing all syllables/words decreased with age, monotony or no stress was retained till eight years. The "t" test results indicated no significant (P0.01) difference between the three language age groups i.e. 2-4 years, 4-6 years and 6-8 years (TABLE-III).

Language Age groups in years	2-4 years Vs 4-6 years	4-6 years Vs 6-8 years	2-4 years Vs 6-8 years
"t" value	1.75	0.64	0.89

TABLE-III: T-Scores

Language age group	2-4 years	4-6 years	6-8 years
"t" values	0.36	0.32	1.48

TABLE-IV: "t" Scores.

Also, the results of "t" test indicated no significant difference (0.01) between males and females in any of the age groups (TABLE-IV). Though, there was no significant difference, in general, the 4-6 age group children performed better than the

other two age groups and within the group, males, in contrary to most of the reported findings, performed better than females.

The results of the Walsh test indicated that no significant difference existed between the trials suggesting high intra judge reliability. Also, the results of the rank correlation test indicated a high correlation ($r=0.89$) between the two judges for all the three stimulus, (words/phrases/sentences). This also indicates high interjudge reliability.

Apart from these, it was noticed that the linguistic category influenced the production of stress. In the age group of 2-4 years it was found that when stress occurred on the first syllable, the pattern was imitated correctly by 60% of the subjects. In the age group of 4-6 years, among the various combinations, the Noun+Noun (N+N) was imitated correctly by 80% of the subjects. The N+N combination was correctly imitated by 60% of the subjects and 70% of the subjects produced staccato voice, if it was the verb which was stressed. In the 6-8 year group 70% of the subjects produced correct stress patterns when the combination was N+N+V, irrespective to which word, stress was assigned. 80% of the subjects produced staccato voice, if it was the Pronoun+Adverb+Verb combination.

Also, the judges reported that the hearing impaired children increased their loudness to indicate stress 80% of the time and the durational changes and pitch changes followed in succession. The pitch changes were less prominent as the hearing impaired children used a high pitched voice, in general.

DISCUSSION

The results reveal several interesting points. First of all, there is a developmental trend in the production of stress in Tamil speaking hearing impaired children between the language age of 2-8 years. This finding is in consonance with the studies on stress conducted on normal subjects. (Blasdell & Jensen, 1970; Rajupratap,1991; Jaya,1992). But it is found that there is a general delay among the hearing impaired children. While in the earlier study on normals (Rajupratap,1991) and Jaya(1992) reported that 90% is achieved by 4 years and 5-6 years respectively. The results of this study indicate that even at the age of 8 years, children did not even obtain 60% scores indicating that the mastery of stress is not yet completed. This could be attributed to the lack of training in prosodic aspects.

Second, comparatively, the 4-6 years age group performed better than the other two groups. This could be because of the material used. The hearing impaired children found phrases easy to repeat though the material was selected considering the vocabulary and grammatical development in that particular age group. In the previous study conducted by Jaya (1992) the "t" test indicated a significant difference in the mean percent scores between 2-4 years and 4-6 years. However, a dip was noticed at 6-7 years of age in both the sex. There were higher scores in the age range of 5-6 years, to which the investigator attributes to the ease of the material used.

Third, in contrary to research studies in this area conducted on normals (Atkinson-King 1973, Jaya 1992), it was found that though not significant, males seemed to perform better than females in the imitation of stress patterns, in all the age groups. This could be attributed to learning factors and the number of years of training.

Fourth, there were no significant differences in the performance of the hearing impaired children at different age levels. This could be attributed to the poor mastery of prosodic aspects, by these children, which could be because of to the lack of training on these aspects. Also, there are no standard teaching strategies for prosodic aspects.

Fifth, while in the age group of 2-4 years, the performance was better when the initial syllable of a meaningful word was stressed, it was not so far a meaningless CVCV string. This may be related to the intra oral air pressure, as subtenly (1968) found that consonants at the beginnings of words have higher intra oral air pressure values than the same consonants located at the end of words. However, the poor performance in the word like titi (though the initial syllable is stressed) may be due to the unfamiliarity of the word. The performance of the 4-6 years age group was better when the combination was N+N, irrespective of the fact, to which word, was the stress assigned. This could be attributed to the grammatical class, as in general, it is opined that Nouns are almost always stressed. The better performance of the 6-8 age group in N+N combination could also be

because of the same factor that nouns are almost always stressed. The poor performance, in combinations of adverbs and adjectives, may be because these hearing impaired children, in general, used less of these forms and so they were less familiar with the adjectives and adverbs.

Sixth, the most common error type was the production of stress on a word that was not intended in the model. This may be due to the complexity of the grammatical class. For eg. if the adjective or the adverb was assigned stress in the model, these hearing impaired children tend to stress the noun, as it is the noun that is usually stressed. Also, the children might have paid less attention to the model or they could not have heard the stress cues due to their hearing loss. The next common error was the production of the word/phrase/sentence with equal stress followed by equal pause for each syllable (i.e. Staccato). This type of error has been reported by several investigators McGarr (1978) Osberger (1978). This could be attributed to their poor control over the laryngeal and articulatory systems which are chiefly responsible for the production of stress patterns. (Brown & Mc Glone, 1974; Starkweather, 1980). The other error was lack of stress on the key syllable/word as such which might be because of the poor intelligibility of their speech, which the judges found very difficult to evaluate and so marked it as "NS" (No stress).

In summary, the results indicate that the development of stress is delayed in the hearing impaired children. This calls for a therapeutic protocol in which stress (Prosody in general) should be given more importance. It is essential that the practicing speech and language Pathologist pays more attention to the prosodic aspects to incorporate it both in evaluation and rehabilitation.

SUMMARY AND CONCLUSION

Learning a language includes not only the segmental aspects but also the suprasegmental aspects. The suprasegmental features are intonation, rhythm and stress. Stress is the comparative force with which the separate syllables of a sound group are pronounced. To put it in simpler terms, stress is the increased effort.

It has been found that stress is affected among the speech disordered population like the dyspraxics, dyslalics and the hearing impaired. In the hearing impaired, suprasegmentals have a greater effect on the speech intelligibility.

This study is focussed on the production of stress in the hearing impaired children. 10 words, 10 phrases and 10 sentences with stress on syllable/word, developed by Jaya(1992) were used as material. 30 hearing impaired children, 10 each (5 males + 5 females) in the language age of 2-4, 4-6 and 6-8 years were studied.

The material was audio presented to 10 children (5 males and 5 females) each in the language age group of 2-8 years in two year age interval. The children were tested individually and were instructed to imitate the model. The written forms of the same were also presented simultaneously with the word to which stress was assigned (underlined). The children's imitation with the model was audio recorded. This audio recording of the imitation was played to two listeners who had to indicate whether

the imitated version was similar to that of the model or not for stress. If it was not the same, they were asked to say how it was different (All stressed or Not stressed at all). The mean percentage of correct responses, different responses, those that were all stressed and those with no stress were calculated separately for each age group. "t" test was applied to find out the difference between the age groups in the production of stress and between males and females. The relation between the production of stress and linguistic factors was also determined. Product moment correlation was used to find out the correlation between the ratings of two judges.

The results of the product moment correlation test indicated that there was high correlation between the judges for words/phrases/sentences indicating that both the judges agreed on the imitation of stress by hearing impaired children.

The results revealed that the production of stress increased from 2 years to 8 years. The 4-6 years age group performed better than the other two groups, though there was no significant age differences. No significant difference between the performance of males and females were observed. However, it was found that males performed better than females, almost in all the age groups. The scores revealed that even at the language age of 8 years, the hearing impaired children did not achieve even 60% score. In general, when the noun was stressed, the hearing impaired children did better than in the adjective or the adverb.

It seems that the acquisition of stress is delayed in the hearing impaired children. The "all stress" pattern and the "monotony" deserves special attention in the evaluation and rehabilitation of the hearing impaired. The working clinician should develop a therapeutic protocol which includes the assessment and evaluation of prosodic features.

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APPENDIX-I

Materials used in the study:

R - indicates the repeated word/phrase/sentence for test - retest reliability.

2-4 years: Words

1. PiPi
2. Kokku
3. tata
4. PaPa^R
5. Kakkā
6. R
7. Kai Kai
8. Vai Vai
9. ti ti
10. PuPu

4-6 years: Phrases

1. tennai maram
2. Pālaik Kāichuhir
3. Kulandai aḷudadu
4. Pū Parittēn^R
5. Sūḍāna Kāppi
6. Kambi mattāppu
7. Mēḍu Paḷḷam
8. Vāḷai iḷai
9. R
10. Pasu nei

6-8 years: Sentences

1. Kūrāna Pencil uḍaiyum
2. avar Kōbamāhak Kattinar
3. appa Kaḍaiyilirundu tirumbinār
4. mān tuḷḷi oḍum
5. āsiriyar Pāḍam naḍattinar^R
6. ennuḍaiya amma ūrilirukkirār
7. Sattamāhap Pāḍam Paḍikkirān
8. Kala Viṭṭil tūnguhirāḷ
9. R
10. Kuḷandai Pāḷ Kuḍittadu

APPENDIX III

System of transcription used (Roman Script)

a	ā	i	ī	u	ū	e	ē	ai	o	ō	au
அ	ஆ	இ	ஈ	உ	ஊ	எ	ஏ	ஐ	ஓ	ஔ	ஆயு
k	g	n̄	c	ñ	t̄	d̄	n̄	t	d		
க	க	ந	ச	நீ	த	த	ண	த	த		
n	p	b	m	y	r	l̄	l̄	v	l̄		
ந	ப	ப	ம	ய	ர	ல	ள	வ	ல		
r	n	h	s								
ர	ண	ஹ	ஸ								