COMPARISON OF INTONATION PATTERNS OF NORMAL HEARING AND HEARING - IMPAIRED SUBJECTS

Reg.No. 4

An Independent Project Work Submitted as Part fulfiment for First Year M.Sc., (Speech and Hearing) to the University of Mysore

ALL INDIA INSTITUTE OF SPEECH AND HEARING
MYSORE - 570 006

TO

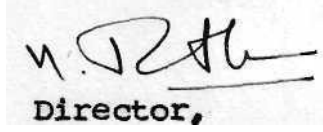
AMMA

CERTIFICATE

This is to certify that the independent project entitled:

"COMPARISON OF INTONATION PATTERNS OF NORMAL HEARING AND HEARING - IMPAIRED SUBJECTS"

is the bonafide work, done in part fulfilment for First Year M.Sc, Speech and Hearing, of the student with Register Number: 4



Director,

ALL INDIA INSTITUTE OF SPEECH AND HEARING

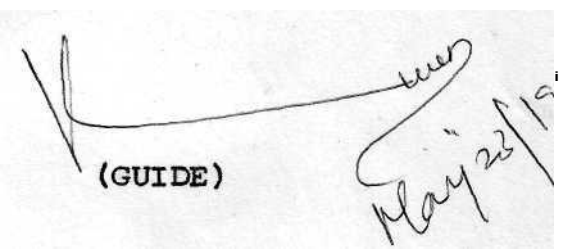
Mysore - 570 006

CERTIFICATE

This is to certify that the independent project entitled:

"COMPARISON OF INTONATION PATTERNS OF NORMAL HEARING AND HEARING - IMPAIRED SUBJECTS"

has been prepared under my guidance and supervision.



D E C L A R A T I O N

This independent project entitled

"COMPARISON OF INTONATION PATTERNS OF NORMAL HEARING AND HEARING - IMPAIRED SUBJECTS"

is the result of my work undertaken under the guidance of Mr. P.J.Kumar, Lecturer in Audiology, All India Institute of Speech and Hearing, Mysore - 570 006, and has not been submitted at any University for any other Diploma and Degree.

MYSORE

DATED: Register No. 4.

ACKNOWLEDGEMENTS_

My sincere thanks to

Mr.P.J.Kumar, Lecturer in Audiology, AIISH, for his guidance and advice.

Dr.N.Rathna, Director, All India Institute of Speech and Hearing, Mysore, for initiating me about this project.

Mr.N.P.Nataraja, Lecturer in Speech Pathology, AIISH, for his invaluable suggestions and help at every stage of my project, without which I could not have proceded.

Mr.L.Viswanath Mirle, Lecturer in English, R.C.College, Mysore, for doing the subjective analysis of the data.

Mr.P.Chandra,, Clinical Assistant, for patiently recording the speech samples.

Mrs.Indira Prakash, for helping me to get subjects for my study.

Ms.Kamini.R. Student (I M.Sc.) AIISH, for writing the stories in kannada in a colloqail form and writing the lists of sentences needed for subjective analysis.

Ms.Pushpa.M.A. for typing my project, and the subjects for their help and co-operation extended during the study.

CONTENTS

C H A P T E R - 1

INTRODUCTION

Whenever human beings live together, they develop a system of talking to each other, even people in the most primitive societies use speech. Speech, in fact is one of those few, basic abilities - that set us apart from animals and are closely connected with our ability to think absolutely.

The development of human civilization is made possible to a great extent - by man's ability to share experiences, to exchange ideas and to transmit knowledge from one generation to another; in other words, his ability to communicate with other men. In short, human society relies heavily on the free and easy interchange of ideas among its members and, for one reason or the other, man has found speech to be his most convenient form of communication.

A convenient way of examining what happens during speech is to take the simple situation of two people talking to each other; one of them, the speaker, transmits information to the other, the listener. The first thing the speaker has to do is arrange his thoughts, decide what he wants to say and put what he wants to say into linguistic formation or units of language (Denes and Pinson, 1973).

1.2

Language is described as the transmission of utterances in an intelligible and meaningful fashion. These utterances are studied in units referred to as 'linguistic units'. The properties of linguistic units are phonology, semantics, morphology and syntactics.

Phonology is that area of language designated as containing the acoustical characteristics of speech. It is divided into segmental and supra-segmental phonemes. Phonemes are elements common to a group of sounds. Segmental phonemes are the vowels, semi-vowels and consonants. The other portion of phonology involves the supra segmental phonemes or the stress, intonation and juncture features of an utterance, (Fry, 1979).

Supra-segmental aspects of speech - intonation, stress, rhythm and juncture are carried mainly by the voiced components of speech. These are the frequency of the fundamental (F) and its harmonics, which are determined by the rate of vibration of the vocal cords? the relative intensity of the syllable, determined by subglottal pressure; by laryngeal adjustment, and by resonances of the vocal tract and duration (Lieberman, 1967).

There is some evidence that early communication is extremely supra-segmental in nature. The infant varies intonation patterns to express physiological and emotional needs (Lewis, 1951; Lenneberg, 1967). Crystal (1973) suggests that infants respond to supra-segmentals at an early age, possibly at the expense: of other linguistic features. He notes that 6-7 months is the most likely period for emergence of nonsegmantal aspects of language. From 9-12 months a. wide range of nonsegmental contrasts is developed (Crystal, 1975) and with increasing age, prosodic patterns become more readily influenced by factors such as vocabulary and phonemic structure.

By 18 months, most normal children use intonation patterns produced by adult speakers in their language environment (Menyuk, 31972) and by 2 years of age have less than 3% error in imitating simple rising and falling inflection (Kressin, Marquardt & Asp, 1976). However, Koike(1977) and Koike & Asp(1977) found that five year old children performed significantly better then three year old children on a more complex suprasegmental task, Although, segmenta1 development stabilizes at eight years of age (Templin, 31953), the age at which suprasegmental development reaches a similar level is not certain.

The role of intonation in the acquisition of language has recieved relatively little attention. Voice patterns that vary inpitch are normally used well before words are learned (Bever, Fodor and Weksel, 1965; Kaplan, 1969) and they appear to facilitate acquisition of both speech reception and speech production skills (Smith and Goodenough, 11971).

The fundamental frequency (P), often loosely called as the pitch, of voiced speech sounds, varies considerably in the speech of a given speaker and the average or characteristic Fo varies over speakers. The F_o varies in the speech of an average speaker over a range of 1 - 11/2 octaves (Fairbanks, 194O). This variation is used to indicate stressed and unstressed vowels, to add emphasis to what is being said and to carry information about the structure and meaning of a sentence. Linguistic and semantic information is carried by pitch in several ways. A falling pitch is used, for example, to signal the end of the final stressed vowel in a declarative sentence*. At a major syntactic break within a sentence, such a fall is followed by a rise in pitch to indicate that the sentence is to continue. For certain types of questions, a pitch rise occurs in the final stressed syllable. Sentences that are ambiguous when printed can be spoken in an unambiguous

way partly because of the intonation, pattern that is imposed on the words. Also, messages beyond the words, sometimes subtle, sometimes poignant can be conveyed by the way the utterance is inflected (Nickerson, 1975).

The fine control of intonation, which involves compensatory adjustments for the maintenance of vocal intensity ,requires the co-ordination of from 12-14 neck muscles and of an even larger number of thoracic and abdominal muscles (Gray and Wise, 31959). It is a small wonder that Voelkar (1935), Green (1956), and Hood(1966) in studies of the voices of children who had made little or no use of their. residual audition, found their intonation to span less than half the normal range of 8-12 semitones.

Pitch has been described as a particularly difficult property of speech for deaf children to learn to control (Boothroyd, 1970). One possible reason for the difficulty is that deaf children may lack a conceptual appreciation of what: pitch is. (Anderson, 1960; Martony, 1968) . A lack of intuitive grasp of the concept may help explain why deaf children often attempt to raise their pitch by increasing their vocal intensity.(Phillips, Remillard, Bass and Pronovost, 1968).

1.6

The ability to hear is essential to the development of natural speech. The normal hearing child learns to talk by listening to and by imitating the speech sounds astound him. Hearing provides. the means by which he can both assess and modify his vocal performance. Intelligible speech is far more than a sequence of discrete. Sounds linked together. The individual sounds must be carefully organised through timing, juncture, stress and intonation. Among theses qualities, intonation has been found to be a particularly elusive quality to the deaf student (Stratton, 1974),

The present study is an attempt to analyse the intonation pattern in normal hearing and hearing-impaired children and to find out in what way, the intonation pattern in hearing-impaired children, deviates from normal hearing children.

Intonation was chosen for three reasons:

1) It is an important, feature of natural and intelligible speech.
2 It tends to be lacking, or incorrect in the speech of hearing impaired persons, and
3) It is a feature most difficult to teach to the hearing-impaired child (Stratton, 1974).

Objectives:

The objectives of the study are:

1) To analyse the intonation patterns in normal tearing children for four basic emotions - Joy, sorrow, fear and anger.

2) To analyze the intonation patterns in hearing-impaired children for four basic emotions - Joy, sorrow, fear and anger, and,

3) To find out the differences between intonation patterns of normal hearing and hearing-impaired children.

Hypothesis:-

The aim of the study is to test the following hypothesis that -

"There is no difference in the intonation patterns used by normal hearing and hearing-impaired children".

Brief Plan of the Study:-

1) Construction of stories incorporating the four emotions – Joy, sorrow, fear and anger.

2) Collection of speech samples from normal and hearing impaired children.

3) Analysis of intonation patterns of normal and hearing impaired children.

Construction of Stories:

Two stories in Kannada were taken - 1)Simha maou Ilu and 2) Kage maou nari. These were written in a colloquial form as if they were being narrated. Four emotions - Joy, Sorrow, anger and fear were present in the stories, each story depicting two emotions.

Collection of Speech Samples:-

Four normal hearing children and four hearing impaired children in an age range of 12-16 years were chosen. They were asked to read out the two stories as if they were being narrated. These speech samples were recorded.

Analysis of Intonation Patterns:-

Both objective and subjective analysis of the intonation patterns was done. objective analysis off the intonation contours was done using a pitch computer. Subjective analysis was. done by one judger who marked the intonation contours according to the pitch levels perceived. Following notations were used for pitch levels - (1) corresponding to low pitch, (2) corresponding to mid-pitch (3) corresponding to high pitch and (4) corresponding to extra-high pitch.

Implications of the Study:-

1) It can give an understanding of the differences in intonation patterns used by hearing and hearing–impaired individuals. That is, it can tell us, at *best* in a limited way, about the role of hearing in intonation.

2) It can give an understanding about the importance of intonation in Speech and Language; hence can be used to stress the need for teaching intonation while teaching speech & language to hearing - impaired individuals.

Limitations:-

1} Intonation patterns o£ only 4 normal hearing & 4 hearing impaired children were studied & compared.

2) The speech samples ware recorded in an experimental situation,

3) The amount of data collected from each subject was limited,. Hence, the inferences drawn in the present study cannot be easily generalized.

Recommendations:-

1) Intonation patterns of a large number of normal hearing and hearing-impaired children needs to be studied.

2) The speech samples are to be collected in real life situation.

3) More data is needed from each subject to draw generalized inferences.

CHAPTER - 2

REVIEW OF LITERATURE

The study of prosody is perhaps one of the oldest branches of the scientific study of language. The term 'prosody' is used more or less synonymously with supra -segmental features. Suprasegmenta1 features are usually either listed as the set of features consisting of pitch, stress and quantity, or defined as features whose domain extends over more than on segment (Hamp, 1975).

Quantity:-

The physiological mechanism that is ultimately responsible for quantity phenomenon is the process involved in the timing of articulatory movements. The physical correlate of the timing of articulatory sequences is the time dimension of the acoustic signal (Lehiste, 1970).

stress:–

Jones (2196.2) defined a strongly stressed syllable; as one that the speaker consciously utters with greater effort than other neighbouring syllables in the word or sentence. Differences in stress are: due to differences in physical effort.. The effort is reflected directly in the activity of the muscles involved in respiration and indirectly in sub-glottal pressure.

Pitchs:-

Pitch is an overlaid function o£ voicing. The fundamental frequency of a voiced segment nay serve simultaneously to identify the segment as voiced and to constitute part of the manifestation of a tonal or intonational pattern (Lehiste, 197O).

"Intonation, like everything else in language, is one instrument in an orchestra" (Bolinger, 1972).

When a layman speaks of intonation he usually means one of two things: the total quality of the sound by which he can distinguish one dialect or language from another whether he understands what is being said or not, and the tone of voice to which he reacts more or less emotionally. The tone of voice comes closer to being purely a matter of fundamental pitch. (Bolinger, 1972).

Every sentence, every word, every syllable, is given some pitch when it is spoken. Even a sound in isolation is produced by vibrations whose frequencies constitute its pitch. There are no pitch-less sentences. (Pike, 1945).

It is a well known fact that intonation patterns are acquired by children even before the actual acquisition of speech sounds. Jakobson identified

two phases of speech development. The 'babbling' stage in which the infant simply exercises his vocal apparatus and makes sounds for the sake of making sounds. Deaf children, for example, babble quite normally for the. first 6 or 7 months of their life. The second stage is from one — two years, when the child begins to use speech sounds in a meaningful way and he employs the distinctions that are operant in the adult speech that he hears. Now the first meaningful element of speech behaviour that can be observed in children actually occurs much earlier than one to two years of age. In the very first few months of life, during the babbling stage, and indeed during the very first minutes of life children employ 'meaningful' intonational signals. The cries are at first meaningful only in that they have a physiological reference. It is believed that these signals, which appear to be innately determined, provide the basis for the linguistic function of intonation in adult speech.

The infant cry has a characteristic pattern. The pattern is apparently innately determined. Mongoloid infants, for example, often lack these characteristic cries and deviations from the normal pattern often signal other neurological abnormalities (Rubinstein, 1964). The infant cry has a rising—

falling fundamental frequency contour. The duration of the cry is usually from 1 - 2 seconds, and the fundamental frequency (FP) initially rises. The FF then remains relatively steady or gradually falls until the end of the cry, when it typically falls at a faster rate (Ostevald, 1963). As the infant matures, the vocalizationsdifferentiate and various types of cries occur.

The shift to intonation as a meaningful speech signal that has a reference to specific social situations is compardtively rapid. Schafer (1922) reported that a nine month old infant who responded to the intonation of the phrase "Wo ist die tick tock?" by looking at the clock, also looked at the clock when similar phrases like, "Wo ist die lala?" were spoken with the same intonation. The same child played hand clapping games when the phrase "mache bitte bitte" was spoken in the exaggerated intonation of the nursery. The child would not respond when the phrase was spoken with a normal intonation.

It has often been noted that children soon mimic adult intonation. A ten month old boy and a thirteen month old girl were recorded under several different conditions. The boy was recorded while he babbled alone in his crib. He was also recorded

while he babbled in an identical play situation with his father and mother. The average of the FF of the child's babbling under these conditions was measured. The same experiment was then repeated with the thirteen month old girl who was just beginning to speak. The average FF of the boy's babbling while he spoke to his father was 340 cps, while his average FF were 390 cps when he was with his mother. (The children's father used lower average FF than their mother). Both of these fundamental frequencies are lower than that of his solitary babbling or crying. The girl also apparently attempted to mimic the FF of her parents (Lewis, 1936).

In an extensive cross sectional study conducted by two Russian investigators, R.V.Tokava and Yampolskaya (1969), using 170 infants upto two years, it was found that at about the first month of life, children reacted to disagreeable situations (hunger, pain) and announced it with a peculiar variation of pitch in the cry. During the second month, sounds of discomfort and placid cooing could be distinguished from sounds of happiness and then laughter appeared during the third month. There after, until the sixth month, the semantic content of the speech sounds was confirmed to these four forms:- discontent, placid cooing, happiness and

laughter, although the number of speech sounds increased.

During the second half year, the. intonational capacities were further augmented. The important observation made was that the new forms of intonational expressions appeared at greater intervals from the third month onwards. Exclamatory delight, with a calmer, satisfied sound were not differentiated in the intonation of happiness until the sixth month. A requesting intonation developed from the seventh month and a questioning intonation did not appear until the. second year (Tokova and Yampolskaya, 1969).

In her study, Evelyn Pike describes an experiment in which she and later, also her husband, Kenneth L.Pike, by design exposed their younger daughter, Barbara in her initial stage of language acquisition, to intonation contours of certain words which were deliberately changed from the normal patterns of English.

Assuming that the child would mimic her own pitch contour, she controlled her speech by using a 2 - 4 falling intonation. That is, instead of pointing to a doll and saying "Baby?" with a rising intonation, she would say it with a falling intonation - 'Baby' was the first word Barbara spoke. She would point to her doll, or pat herself, and say 'Baby' with a falling intonation.

About the same time a new word with a different intonation was chosen to be taught. The word chosen was "Daddy!" and the intonation was that of a call; the first syllable was long and extra high; on pitch one and the second was somewhat long and on pitch 2 or 3. After some days Barbara called out to her father in the same intonation.

After she was using both words well, Barbara had to be left with another American family. These people had not been told of the experiment, so naturally enough they made no attempt to control their intonation. On the parents return it was found that Barbara had largely stopped using the falling intonation and had substituted a rising one on "Baby". This little experiment indicated that children mimic pitch very early; that those used by their elders spoken directly to them are the ones they learn first.

At some point in the development of speech, intonation takes a linguistic reference. This occurs quite early, before; the child has acquired many of the distinctive features of his linguistic environment.

Lewis (1936) noted three stages in the development of language:- 1. At an early stage, the child shows discrimination in a broad way between different patterns of expressions in intonation.

2. When the total pattern - the phonetic form together with the intonational form is made effective by training, at first the intonational rather than the phonetic form dominates the child's response.

3. Then the phonetic pattern becomes the dominant feature in evoking the specific response. But while the function of the intonational pattern may be considerably subordinated, it certainly does not vanish.

The above studies outline the development of intonation patterns and its importance in speech in as young an age as a few post natal months.

There are very few studies in the area of 'Hemispheric specialization, for intonation. Blumstein and Cooper (1974), conducted 2 dichotic experiments to investigate the lateralization of intonation contours. In the first experiment, intonation contour that had been filtered from real speech examples of 4 English sentence types yielded a significant left ear advantage. In the second experiment, non-filtered versions of 4 intonation contours superimposed on a nonsense syllable medium as well as their filtered equivalents were presented to subjects, again in a matching task. For both sets of stimuli, a left ear advantage was obtained.

Safer and Leventhal (1977) did 2 experiments in which lateralization of monaural, auditory input affected the evaluation o£ verbal passages, in experiment one, subjects listened to taped passages that consisted o£ three levels (positive, neutral and negative) of tone of voice crossed with three levels of content or meaning which were similar to the previous, making a total of 9 different tone/content combinations. Subjects rated these passages as neutral, positive or negative and although they were not instructed about which cues (tone or content) to use, 29 of 36 subjects who listened on the right ear used the content cues. In experiment *2,* subjects were asked to make objective ratings of both tone of voice and content. Subjects who listened on the right ear were more accurate in rating both cues.

Results from the- two experiments suggest that the right hemisphere is directly involved in the perception of intonation contours and that normal language perception involved the active participation of both cerebral hemispheres.

Speech is organized in terms of the expiratory air flow from the lungs. At the end of each expiration, the flow of air out of the lungs ceases and the sub-glottal air pressure abruptly falls. The fundamental frequency of phonation is directly proportional to the sub-glottal

air pressure.

It is a universal of human speech that, except for certain predictable cases, the FF of phonation and acoustic amplitude fall at the end of sentence. The physiological basis of this phenomenon may be a condition of least articulatory control. If the tension of the laryngeal muscles is not deliberately increased, at the end of expiration when the subglottal air pressure falls, the FF of phonation will also fall. This pattern of articulatory activity thus produces a prosodic pattern that is characteristic of the ones that are used to delimit the boundaries of un-emphatic, declarative sentences in normal speech. The FF of the vibrating vocal cord appears to be a function of the subglottal air pressure and rises from a medium pitch to a higher pitch at the stress peak (which occurs at the peak subglottal air pressure) and then falls as the subglottal air pressure falls at the end of the utterance, (Lieberman, 1968).

Within intonation, the linguistic features of intonation are determined by factors like the FF, intensity and duration. Most of the investigators refer to the FF as the essential ingredient of intonation, but some do not.

"The intonational differences heard as high or low.

rising or falling are primarily related to the frequency of the sound waves", (Lado, 1960).

-The pitch variation in the intonation of a language constitute a system of distinctive units and patterns. It is found that English intonation has 4 distinctive pitch units. They are called as low, mid, high and extra high and are represented with numbers above the line of print (Lado, 1961; Kurath, 1971 and Bolinger, 1971).

Letting 1. represent low, 2. mid, 3. high and 4. extra high, an example would be,

```
        2                  4
 telephone number!   (mid - extra high)
```

The absolute pitch of these units varies for different speakers and even for the same speaker on different occasion or in different parts of the same conversation.

All the units are higher when speaking to some one at a distance; they are lower when speaking softly, the interval between the units are greater when the speaker is emotionally excited, etc, (Lado, 19615.

While emphasizing the role of fundamental frequency or pitch in intonation, Pike (1945) states that "every sentence, every word and even every syllable is given some pitch when it is spoken."

Although Pike (1945) and Lado (1961) believe that

variation in fundamental frequency is the basis for various intonation contours, it was shown not to be true always by Denes (1959) from his experiments. According to him, it is still possible that variations of other acoustic characteristics like intensity, duration or of spectrum, may also serve as cues for the recognition of intonation. He obtains the support for this statement from whispered speech. He says that - "in whispered speech there is no vocal cord vibrations, and hence no fundamental frequency, but still the speaker is able to convey to the listener much of the informations that is normally considered to be contained in the form of intonation."

Pollack, Rubenstein and Harovitz, (1960) conducted their experiment using whispered speech in order to find out the importance of fundamental frequency in the determination of intonation and concluded that the fundamental frequency is not the only determiner of the intonation contours.

Infant vocalization, convey meaning to the parent who hears them. Mallard and Daniloff (1973) did a study to determine which acoustic parameters were important to a mother's judgement of her child's vocalization along a "pleasure - distress" perceptual dimension.

24 vocalizations of a four month old child were judged by the child's mother for emotional content. An acoustical analysis was performed on the samples. Multiple regression analysis revealed that glottal frequency best predicted judgements of emotional state, whereas duration and intensity were of lesser importance. As the fundamental frequency increased, the tendency bo rate the vocalization as distressed also increased. The authors concluded that "Glottal activity, particularly glottal frequency, may be a crucial parameter in an infant, signalling his emotional state to a listening parent."

Huttar (1968) conducted a study wherein the emotional states of an adult male American speaker, as reflected in 30 utterances, were evaluated by 12 subjects on *9,* seven point semantic differential scales. The emotional states of the person whose speech was studied were measured indirectly by means of' listener's response, and the prosodic features of the utterance were studied by 2 means :-

1, Acoustically by means of a sound speetrograph.
2, Perceptually by means of listener's response.

High correlations were found between the acoustic variables and judgements of degree of emotion.

Correlation coefficients between judgements of emotion and judgements of prosodic features were in general higher than the correlations involving the acoustic variables. Degree of perceived emotion were found to be highly and positively correlated with fundamental frequency range and intensity range,

Lieberman and Michaels (1962) carried out an experiment to examine the contributions of fundamental frequency and of amplitude to the transmission of the emotional content of normal human speech. The conclusions drawn were - 1. There is no single acoustic correlate of the emotional modes. Phonetic content, gross changes in fundamental frequency, the fine structure of the fundamental frequency, and the speech envelope amplitude, in that order, all contributed to the transmission of the emotional modes,

2. Different speakers favoured different acoustic parameters for the transmission of the same emotional mode.

3. The fine structure of the fundamental frequency, that is, the perturbations in fundamental frequency, appears to be an acoustic correlate of the emotional modes. When these perturbations were smoothed out confusions between the emotional modes increased.

The above studies state the importance o£ fundamental frequency as a carrier of intonation.

Some researchers like Bolinger (1972) consider intonation as only a peripheral part of oral communication. According to Bolinger/ "Intonation is not as central to communication as some of the other traits of language. If it were so, we could not understand some one who speaks in a monotone". This is like saying that voicing is not crucial to communication because we can understand whispered speech (Ling, 1971).

On the other hand, Lieberman (1967) believes that intonation plays a central role in the process o£ recognition of syntactical arrangement of words.

Intonation characteristics may be roughly divided into several types. Some contours may be completely colourless in meaning. They represent the intonational minimum of speech, and some mechanical function. Nevertheless, these mechanical contours may be very important for learning a language, since failure to use them would immediately label a speaker as a foreigner width a bad accent. Other, intonation characteristics may be affected or caused by the individual's physiological state - anger, happiness, excitement, age, sex, and so on. These help one to identify people and to ascertain how they are feeling

(Pike, 1945).

Words have basic. Intrinsic meanings; these lexical meanings are the ones found in the dictionary. The intonation meaning is quite the opposite. Rather than contributing to the intrinsic meaning of a word, it is merely a shade of meaning added to or super imposed upon that intrinsic lexical meaning, according to the attitude of the speaker. Actually, we often react more violently to the intonational meanings than to the lexical ones. In actual speech the hearer is frequently more interested in the speaker's attitude then in his words - that is, whether a sentence is 'spoken with a smile or with a sneer (Pike, 1945),

"Intonation is the salt of an utterance. Without it, a statement can be often understood, but the message is tasteless, colourless. Incorrect uses of it can lead to embarrasing ambiguities." (Delattre, 1966;

The grammatical function of English intonation is two folds -

1. It signals the end, or the imminent end of a sentence or of one of its constituent phrases.
2. It serves to distinguish the 'Yes or no' questions from all other types of sentences." (Kurath, 1971).

Bloomfield (1933) argues that intonation contours

must be morphemes because intonation carries meaning. Since the intonation contours are determined by various pitches, these pitches, these pitches must be phonemes.

Bolinger, (1975) states that there are 3 features of intonation which have similar uses in all languages. They are:-

1. Range:

The range conveys emotions. When we are excited our voice extends its pitch upwards. When we are depressed, we speak almost in a monotone.

2. Direction:

It is usually connected with pause.

3.Relative height:

It is associated with the importance given to particular word or words in a sentence.

Intonation also plays a useful role in the determination of voice quality, (Brown, Strong, and Rencker, 1973) and in recall of verbal materials (Leonard, L.B., 1973).

Previously only subjective measurement of intonation patterns were available. With the advancement of technology quite a few measuring devices have come up in instrumental phonetics. A few of them are outlined here.

One of the first measuring devices was the kymograph described by Rouselot (1897 - 1908). The principles of the apparatus are simple. The sound waves of the word are transmitted by a rubber tube to a drum, which is caused to vibrate. A recording stylus mounted on the drum inscribes the vibrations on a sheet coated with lampback attached to a cylinder revolving at a constant speed. A kymographic tracing does not suffice to analyse the distinction sounds of the word (its phonemes), but it is good enough to study the three prosodic parameters, duration, intensity and pitch.

The oscilloscope can be used for the same purpose as the kymograph, but it is more precise. The oscilloscope makes it possible to represent the sound waves by a curve produced on the screen of a cathode ray tube, through the movement of a luminous spot created by the impact of the electrons on a fluorescent coating (Leon and Martin, 1970).

The spectrograph is a much more versatile instrument for analysis than the oscillograph. It is a spectral analyzer into which a recording of not more than 2.4 seconds can be fed to obtain a spectro gram representing the harmonics of the sound on a frequency scale of 50Hz to 8OOO Hz. The changes in

intonation can be observed by following the curve o£ the fundamental, (Leon and Martin, 1970).

The melodic analyser - In brief the system consists of a series of filters ranging from 70 to 500 Hz, a computer program and a sub program. The computer tries to detect in which channel the fundamental frequency is being filtered and, by comparing the values that have gone before and the values that come after the one that is being examined, it tries to be sure of extracting the fundamental frequency and not the second harmonic. The fundamental pitch curve is produced on the screen in real time, that is , it is traced as the speaker speaks, (Leon and Martin, 1970).

Laryngography:

The laryngograph responds only to vocal fold vibration employing 2 electrodes super-ficially applied at each side of the speaker's larynx. As the subject speaks, the instrument responds to changes in electrical impedance caused by the adduction and abduction of the vibrating vocal folds. It gives information about vocal fold closure. The output of the laryngograph is called Lx. Lx is used as the basis of the display of fundamental frequency. Each individual larynx period is measured and the negative of its logarithm derived. In

this manner, period by period variations in excitation can be shown with in the overall contour/ with a logarithmic vertical frequency scale and a horizontal time scale, (Abberton and Fourcin, 1972).

The fact that profound pre-lingual deafness prevents the normal acquisition of speech is well known. It is recognized that no two individuals, whether they have hearing or not, produce speech that is exactly the same. Nonetheless, studies have shown that, on the average, the speech of individuals with a profound hearing loss that dates either from birth or shortly after that, tends to differ in some quite specific ways from the speech of people with normal hearing, (Nickerson, 1975).

Asp (1973) has suggested that the level of supra-segmental development may be an important determinant of the intelligibility level achieved by hearing impaired children. Supra-segmentals may function in a similar manner in children with inadequate articulation. Thus supra-segmental skill acquisition might be serving not only to facilitate segmental development, but also to improve intelligibility.

Since voicing information is normally present below 300 Hz, the supra-segmental features should be

audible to most hearing impaired children including those with only low frequency residue, if appropriate amplification is provided (Ling, 1964).

Speech of 10 congenitally deaf teenagers was recorded and analized spectrographically. They tended to produce longer vowels before voiced stops, but to a considerably smaller extent than normal hearing speakers. In triads of CV syllables the subjects produced stress by increased intensity without a significant change in fundamental frequency. In noun verb pairs in sentence format the subjects failed to significantly adjust intensity or frequency, (Sussman and Hernandez, 1980).

The difficulties that the deaf speaker has with pitch are of 2 general types:- in-appropriate average pitch and improper intonation. Intonation problems may in turn be divided into 2 major types:- Monotoneus voice and excessive or erratic pitch variations, (Nickerson, 1975).

Deaf speakers tend to vary the voice pitch much less than do hearing speakers, and the resulting speech has been described as flat or monotone (Calvert, 1962; Hood, 1966; Martony, 196S). A particular problem is that of inappropriate or insufficient pitch change at the end of a sentence (Sorenson, 1974).

A terminal pitch rise - such as that occuring at the end of some questions may be even more difficult for a deaf child to produce than a terminal fall (Phillips, Remillard, Bass and Pronovost, 1968). Deaf speakers who tend to produce each syllable with equal duration may also generate a similar pitch contour on each syllable. Such speakers may fail to indicate variations in stress either by changing the syllable durations or by modifying the pitch contours on the syllables. Thus for example, a common error would be to fail both to shorten an unstressed syllable and to lower the pitch on such a syllable, (Nickerson, 1975).

It has been suggested that some of the unusual pitch variations that occur in the speech of deaf persons may result from attempts by the speaker to increase the amount of proprioceptive feedback that he receives from the activity of producing speech, Martony (1968) and Willemain and Lee (1971) have observed that deaf speakers sometimes tend to begin a breath group with an abnormally high pitch and then to lower the pitch to a more normal level.

Controlling intonation, that is, the pitch contour in time, involves controlling the activity of the vocal cords. Hearing children learn to manage

this at a very early age. Through practice, control becomes habitual , requiring little conscious effort. However, for the deaf child, acquiring this skill is far more difficult. Without hearing or little residual hearing, there is little sensory information available concerning activity within the larynx. As a result, pitch remains an abstraction, difficult to comprehend, (Stratton, 1974).

Helping the child to develop feed forward and feed back control of pitch to generate appropriate intonation patterns may be much more difficult unless the child has sufficient low frequency residual hearing and uses a hearing aid with an adequate low frequency response to establish voice control through auditory proprioceptive experience. Residual hearing capacity need not be extensive for this purpose. The frequency range of 100 - 500 Hz is sufficient to encompass the fundamental frequency range normally met in male and female adults and children, (Ling, 1964).

When dealing in the clinic with speech and language disorders involving intonation, speech and language clinicians face the practical problems of recognition and definition of the normal and pathological patterns involved and their presentation to

patients during remedial work. This project is an attempt to analyze the intonation patterns of normal and hearing impaired subjects and to find out in what way the intonation pattern is hearing impaired subjects deviate from that of the intonation patterns o£ normals.

CHAPTER - 3

METHODOLOGY

The purpose of the study was:

1) To analyse the intonation patterns in normal-hearing children for four primary emotions - Joy, Sorrow, Fear and Anger.
2) To analyse the intonation patterns in hearing-impaired children for four primary emotions - Joy, Sorrow, Fear and Anger, and
3) To find out the differences in intonation patterns used by normal hearing and hearing impaired children.

For the study of the purposes, the following were necessary:

1) Construction of stories incorporating the four emotions - Joy, sorro, fear and anger.
2) Collection of speech samples.
3) Analysis of intonation patterns.

1) Construction of Stories:

Two simple stories - (a) "Simha mattu ili" and b) "Kage mattu nari" were chosen. The first story incorporated the primary emotions of anger and fear, whereas the second incorporated the primary emotions of joy and sorrow. This was done to depict them in context. These stories were written down in a

spoken form language as when somebody narrates a story.

2) Collection of Speech Samples:-

Subjects:- Four normal hearing subjects and four hearing impaired subjects in the age-rangeof 12 - 16 years were chosen. There were four males and four females. All subjects chosen could speak in sentences. All of them were native speakers of Kannada.

The subjects were instructed to read through the stories as if they were narrating it to somebody. Before recording the speech sample, they were asked to read through the stories once.

Recording:- The speech sample was recorded on the spool tape of the four-track "UHER tape recorder", at a tape speed of *71/2* ips. Later only the four particular sentences depicting the four primary emotions from the two stories narrated by each subject, were separated from the rest of the speech sample for the purpose of analysis.

3) Analysis of intonation patterns:-

Both subjective and objective analyses of the speech samples were done.

Subjective analysis: - A native speaker of Kannada was chosen as the judge. He marked the various pitch

levels of each sentence as he perceived it. The pitch levels were from 1 to 4, with 1. denoting low pitch, 2 denoting mid pitch, 3 denoting high-pitch and 4 denoting extra high pitch. The speech spectrograph (Voice Identification-700) was used here. This had the facility of a tape clamp which allowed the taped material clamped over the drumhead to be repeated again and again. This facilitated the judge to listen to the sentences any number of times to decide the pitch levels for each sentence recorded.

Objective analysis:-

The equipment used for objective analysis of the data was as follows:-

1. Spool tape recorder.
2. Digi-pitch or pitch analyzer (Model DPM 10S) | Both of these are part of the speech spectrograph Voice Identification-700
3. Measuring amplifier (Bruel and Kjaer, Type 2606)
4. Level Recorder (Bruel and Kjaer, Type, 2305)

The block diagram of the set-up has been given in figure (1). Here the taped material was fed to the optional part of the speech spectrograph. The output of this was fed to the measuring amplifier and then onto a level recorder. The fundamental frequency contours of each sentence was this recorded.

The equipment used for obtaining a scale for the fundamental frequency was as follows:

1. Beat frequency oscillator (Bruel and Kjaer, Type 1022)
2. Digipitch or pitch analyzer - Model DPM 10 S
3. Measuring amplifier (Bruel and Kjaer, Type 2606)
4. Level Recorder (Bruel and Kjaer, Type 2305)

The block diagram of the set-up has been given in the Figure I. Here the taped material was fed to the optional part of the speech spectrograph. The output of this was fed to the measuring amplifier and then onto a level recorder The fundamental frequency contours of each sentence was thus recorded.

The equipment used for obtaining a scale for the fundamental frequency was as follows:-

1. Beat frequency oscillator (Bruel and Kjaer, Type 1022.
2. Digipitch or pitch analyzer - Model DPM 10S
3. Measuring amplifier (Bruel and Kjaer, Type 2606).
4. Level recorder (Bruel and Kjaer, Type 2305.] P.o.

The block diagram of the set up has been given in figure II. Tones of different frequencies from 100 Hz to 600 Hz were fed from the Beat frequency oscillator to the pitch analyzer. The output from this was given again to the measuring amplifier and

then onto the level recorder. The different frequencies concesponding to thetone being fed were masked on- the paper of level recorder. Using this a scale was developed for frequencies between 100 Hz and 6OO Hz.

After obtaining the frequency variation in each sentence through objective analysis, the frequency range of 100 Hz to 600 Hz was divided into four pitch levels from 1 - 4 respectively for purpose of comparison with subjective analysis.

100 Hz to 140 Hz = 1 or: low pitch.

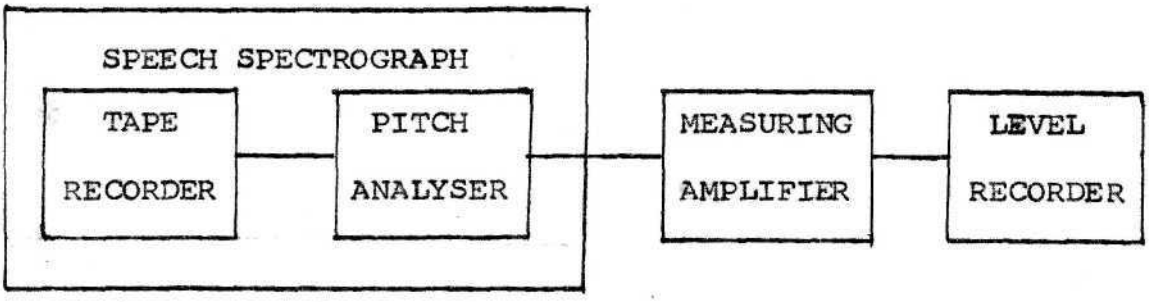
141 Hz to 200 Hz = 2 or mid pitch.

200 Hz to 300 Hz = 3 or high pitch.

300 Hz to 400 Hz = 4 or extra high pitch.

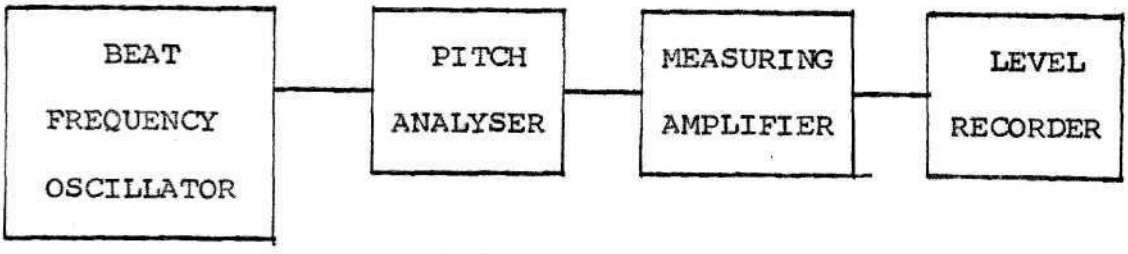
So the corresponding pitch levels were marked on the intonation contours or fundamental frequency contours obtained through objective analysis. This enabled the compaarison of the intonation contours obtained by both subjective and objective analysis, as both had been marked in terms of pitch levels now.

Figure - I



EQUIPMENT USED TO OBTAIN FUNDAMENTAL FREQUENCY CONTOURS

Figure - II



EQUIPMENT USED FOR OBTAINING A SCALE FOR FUNDAMENTAL FREQUENCY

The data was analyzed using appropriate procedure.

C H A P T E R - 4

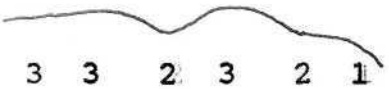
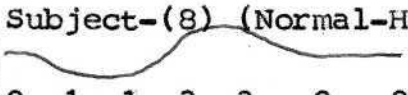
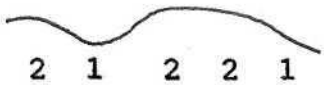
RESULTS AND DISCUSSION

The final intonation contours obtained from both objective and subjective analysis were finally denoted in terms of pitch levels according to the procedure specified in the preceding chapter.

The different pitch levels obtained from both objective and subjective analysis for the four primary emotions - Joy, sorrow, anger and fear for the eight subjects has been given below: -

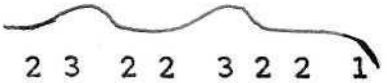
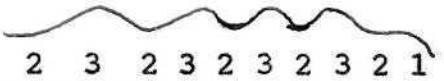
Sentence -1. depicting the emotion 'Anger'

"e nInn3n ɵInð hākbIḍɵIn noḍu."

Objective analysis	Subjective analysis
Subject(1)(Hearing-impaired)  1 2 2 1 2	 3 3 2 3 2 1
Subject(2) (Hearing-impaired)  1 2 2 1 2	 3 2 3 3 2 3
Subject(3) (Normal Hearing)  1 2 2 1 2 2	 2 2 3 3 2 3 4
Subject-(4) (Normal Hearing)  2 1 2 3 4	 2 3 3 2 3 4
Subject-(5) (Normal Hearing)  1 2 3	 2 3 2
Subject-(6) (Hearing -impaired)  1 2 1 2 1 2 1 2	 1 1 2 1 2 3 1 2
Subject-(7) (Hearing-impaired)  1 2 2 1 2 1 2 1	 3 1 3 3 1 3 3
Subject-(8) (Normal-Hearing)  2 1 1 3 3 2 2	 2 1 2 2 1

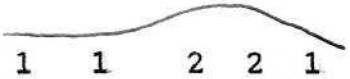
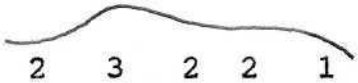
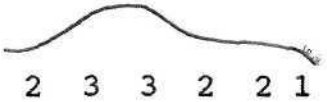
Sentence-(2) depicting the emotion 'fear'

"nannan bItbIdappā nIg kaʃta banðāg nān kandIθa sahaja madθInI."

Objective analysis	Subjective analysis
Subject-(1) (Hearing-impaired)  1 2 1 1 1	 2 1 3 2 3 1 2 1 2
Subject-(2)(Hearing-impaired)  1 1 1 2 1 1	 2 3 2 2 3 2 2 1
Subject-(3)(Normal-Hearing)  1 2 2 1 2 1 2 1	 2 3 2 3 2 3 2 3 2 1
Subject-(4)(Normal-Hearing)  1 2 1 2 2 1 2	 2 3 2 3 3 2 2 3 2 3
Subject-(5)(Normal-Hearing)  1 2 1 1 2 1 2 1	 1 2 2 3 2 3
Subject(6) (Hearing-impaired)  1 2 1 1 2 2 1 3 2	 2 2 3 2 1 2 2 2
Subject(7)(Hearing-impaired)  1 2 2 1 2 2 1 2 1 2 1 1 2	 1 3 3 2 2 3 1 3 3 1 3 1 2 3
Subject(8)(Normal-Hearing)  2 3 3 2 3 2 3 2	 2 2 3 2 3 2 1 2 2 3

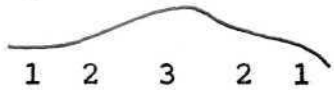
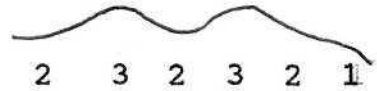
Sentence-(3) depicting the emotion 'Joy'

"eʃ tu ðod rottI tʃ uru! "

Objective analysis	Subjective analysis
Subject(1)(Hearing-impaired)  1 2 1 2	 2 2 3 2
Subject(2) (Hearing-impaired) 1 1 1 1	 3 2 3 2 3 2 2
Subject(3) (Normal-Hearing)  1 1 2 2 1	 1 2 3 2 3 2 2
Subject(4)(Normal-Hearing)  1 2 4	 2 3 4
Subject(5)(Normal-Hearing)  1 2 2	 2 3 2
Subject(6) (Hearing-impaired)  1 1 2 1 2 1	 1 1 2 2 1
Subject(7) (Hearing-impaired)  2 3 2 2 1	 2 3 3 2 2 1
Subject(8) (Normal-Hearing)  1 2 3 4	 2 2 3

Sentence(4) depicting the emotion 'Sorrow'

"ajo nanag eInak enu Illa"

	Objective analysis	Subjective analysis
Subject(1) (Hearing-impaired)	 1 1 2 1 1 2	 2 2 3 2 3 2
Subject(2) (Hearing-impaired)	 1 1 1 2 1	 2 3 2 2 1 2 1 2 2
Subject(3)(Normal-Hearing)	 1 2 1 1 3	 2 3 2 2 3 2 3 2 2
Subject(4) (Normal-Hearing)	 1 2 2 3	 2 3 2 3 2 3 2
Subject(5) (Normal-Hearing)	 1 2 3 2 1	 2 3 2 3 2 1
Subject(6) (Hearing-impaired)	 2 3 2 2 1 2 3 2	 1 2 1 2 1 2 2
Subject(7) (Hearing-impaired)	 1 2 1 1 2 2 1	 2 3 2 2 3 2 2 1
Subject(8) (Normal-Hearing)	 1 2 3 4	 2 3 2 3

Comparison of. subjective and objective analysis of intonation patterns:-

The intonation contours obtained from both objective and subjective analysis were compared. Among the 32 intonation contours compared, only 13 contours matched for those obtained from both objective and subjective analysis, This amounts to about 40.62% of the data. Pine variations in pitch levels are better analyzed through objective analysis. The intelligibility of the sentence affected the perception of the pitch levels in subjective analysis$_t$ as reported by the judge.

Comparison of intonation patterns of normal hearing and hearing - impaired subjects:-

Sentence *1* Dipicting the emotion 'Anger'.

1. Three normal hearing subjects (subjects 3,4, 5) and three hearing impaired subjects (subjects 1, *2,* 6) ended the sentence with a rising pattern and one normal hearing subject (subject 8) and one hearing impaired subject (subject 7) ended the sentence with a failing pattern.

2. Variations in pitch levels varied from 1 to 3 for normal hearing subjects and variations in pitch levels varied from 1 to 2 for hearing impaired subjects.

Sentence *2* Depicting the emotion 'Fear.'

1. Three normal hearing subjects (subjects 3, *5, 8)AND* all hearing impaired subjects ended the sentence with a falling pattern and one normal subject (subject 45 ended the sentence in a rising pattern. In the case of hearing impaired subjects, variations in pitch in the last segment of the sentence was not present. The pitch was monotonous.

2. Variations in pitch levels for both normal hearing and hearing - impaired subjects varied over 2 pitch levels, either from 1 to 2 or 2 to 3.

3. More variation in pitch levels were present over the sentence spoken by normals than by hearing - impaired subjects.

Sentence _3 Depicting the emotion 'Joy'.

1. Three normal hearing subjects (subjects *4,* 5, 8) and one hearing — impaired subject (subject 1 ended the sentence with a rising pattern. One normal hearing subject (subject 3) and two hearing impaired subjects (subjects 6, 7) ended the sentence with a falling pattern. One hearing impaired subject (subject 2) had a monotonous pitch throughout the sentence.

2. Variations in pitch levels for normal hearing subjects varied from 1 to 4 where as for hearing impaired subjects it extended from 1 to 3.

3. All normal hearing subject had sharp variations in the contour. For hearing impaired subjects, the variations in the contour were gradual.

Sentence 4 Depicting the emotion 'Sorrow'.

1. 3 normal hearing subjects (subjects 3, 4, 8) and and one hearing impaired subject (subject 1) . ended the sentence with a rising pattern. One normal hearing subject (subject 5) and three hearing impaired subjects (subjects *2,* 6, 7) ended the sentence with a falling pattern.

2. Variations in pitch levels for normal hearing subjects varied from 1 to 4 and variations in pitch levels for hearing impaired subjects varied over 2 pitch levels either from 1 to 2 or from 2 to 3.

Fundamental frequency used by the subjects:-

The fundamental frequency or habitual pitch of the subjects was found out by noting the pitch used most often by the speakers. This was noted from the fundamental frequency contours obtained through objective analysis.

The results are given in the table below.

Subject	Fundamental frequency	Normal or Hearing impaired
(1)	100 Hz	Hearing-impaired
(2)	100 Hz	Hearing-impaired
(3)	140 Hz	Normal Hearing
(4)	134 Hz	Normal Hearing
(5)	140 Hz	Normal Hearing
(6)	120 Hz	Hearing-impaired
(7)	150 Hz	Hearing-impaired
(8)	210 Hz	Normal Hearing

The. results of the analysis can lead us to draw the following inferences:-

1. Variations in pitch levels of hearing - impaired subjects were less than those of normal - hearing subjects in the present study. This is in line with the observations of others, (Calvert, 1962, Hood, 1966, Martony, 1968). They state that deaf speakers tend to vary the pitch of their voice lesser than the hearing speakers. The resulting speech of the deaf has been described as flat or monotonous.

2. Hearing impaired subjects did not have the same rise and fall pattern as normal hearing subjects in the present study.

Sorenson (1974) has stated that a particular problem in case of deaf speakers is that of in-appropriate or insufficient pitch change at the end of a sentence.

3. The duration over which the speech segment extended was more in case of hearing impaired subjects than in the case of normal hearing subjects. It is probably due to this, the variations in intonation patterns tended to be more gradual in hearing impaired subjects and

not as sharp as in case of normal hearing subjects.

Owing to above inferences, the hypothesis that "there is no difference in the intonation patterns used by normal hearing and hearing impaired subjecrs" was rejected, within the limits of this study.

C H A P T E R ' S

SUMMARY AND CONCLUSIONS

The purpose of this study was to analyse and compare the intonation patterns of normal - hearing and hearing - impaired subjects.

For this purpose two simple stories in Kannada- 1. Simha mattu ili and 2. Kage mattu nari were chosen. Each of these stories depicted two primary emotions - fear and anger and joy and sorrow respectively. This was done to depict them in context. The stories were written down in a spoken form language, as if they were being narrated to somebody.

Pour normal hearing subjects and four hearing impaired subjects in an age range of 12 - 16 years were selected for the study. They comprised of four females and four males, who could speak in sentences and were native speakers of kannada.

The subjects were instructed to read through the stories as if they were narrating it to somebody Before recording the speech sample, the subjects were asked to go through the stories once.

The speech samples were recorded in the spool tape of the four track, 'Uher tape recorder' at a tape speed of 71/2 lps. Later, only the four sentences depicting the four primary emotions, said by each

ease were segmented from the rest of the speech sample. These were taken up for analysis.

Both subjective and objective analysis of the data were carried out. During subjective analysis, a native speaker of kannada marked by the intonation pattern of the sentences according to the pitch levels he perceived. This gave the pitch variation in each sentenced Here pitch levels used were from 1 to 4, with 1 corresponding to low pitch, 2 to mid pitch level, 3 to high pitch, and 4 to extra high pitch level.

For the purpose of objective analysis, the following equipment were used:-

1. Spool tape recorder,
2. Digi-pitch or pitch analyzer,
3. Measuring amplifier (Bruel and Kjaer) and
4. Level recorder (Bruel and Kjaer).

The speech sample from the tape was fed to the pitch analyzer which analyzed the data in terras of fundamental frequency contours which is considered as the main carrier of intonation patterns. The output of the pitch analyzer was fed to the measuring amplifier and in turn to the level recorder where the fundamental frequency contours were recorded on the level recorder paper.

For the purpose of obtaining a scale for the fundamental frequency, the following equipment were used:

1. Beat frequency oscillator (Bruel and Kjaer),
2. Pitch analyzer,
3. Measuring amplifier (Bruel and Kjaer) and
4. Level Recorder (Bruel and Kjaer).

Tones of different frequencies were fed from the beat frequency oscillator to the pitch analyzer. The output from this was again fed to measuring amplifier and then into the level recorder. The different frequencies in the range of 100 Hz to 600 Hz were marked on the level recorder paper to obtain a scale for fundamental frequency.

The each fundamental frequency contour obtained for each sentence from every subject was marked in terras of the fundamental frequency according to the scale obtained.

The range of 100 Hz to 400 Hz was divided into four pitch levels of 1 to 4 respectively for the purpose of comparing the results of subjective and objective analysis, viz:

loo Hz to 140 Hz = 1 or low pitch.

1.41HZ to 200 Hz = 2 or mid pitch.

200 Hz to 300 Hz = 3 or high pitch.

300 Hz to 400 Hz = 4 or extra high pitch,

Using the above scale fundamental frequency or intonation contours obtained from objective and subjective analysis were marked in terms of pitch levels, 1 to 4, which enabled the comparison between intonation contours obtained from normal hearing and hearing impaired subjects.

The intonation contours of normal hearing and hearing impaired subjects were compared to test the following "hypothesis" that "There is no difference in the intonation patterns of normal hearing and hearing impaired subjects."

The analysis and comparison of the results led to the following inferences, rejecting the hypothesis with in the limits of the present study.

1. Variations in pitch levels of hearing impaired subjects were less than that of normal hearing subjects.

2. Hiaring - impaired subjects did not have the same rise and fall patterns as normal hearing subjects.

3. I*n* the present study the duration over which the speech segment extended, was more in case of

hearing subjects. It is probably due to this, the variation in intonation patterns tended to be more gjradual in hearing - impaired subjects and not as sharp in the ease of normal hearing subjects.

Limitations:-

1) Intonation patterns of only 4 normal hearing &
2) 4 hearing impaired children were studied and compared,

2) The: speech samples were recorded in an experi-mental situation.

3) The amount of data collected from each subject was limited. Hence, the inferences drawn in the present study cannot be easily generalized.

Recommendations:-

1) Intonation patterns of a large number of normal hearing and hearing - impaired children needs to be studied.

2) The speech samples are to be collected in real life sttuation.

3) More data is needed from each subject to draw generalized inferences.

Implications of the study:

1) It can give an understanding of the differences in intonation patterns used by hearing and hearing impaired individuals. That is, it can tell us, at best in a limited way, about the role of hearing in intonation,

2) It can give: an understanding about the importance of intonation in Speech and Language; hence can be used to stress the need for teaching intonation while teaching speech and language to hearing - impaired individuals.

REFERENCES

Abberton, E. & Four in .A . J . Laryngographic analysis and intonation British Journal of Communication Disoorders 7 (1), 1972, 24 - 27.

Anderson. F. "An Experimental pitch indicator for training deaf scholar" - Journal of Acoust ical Society of Americai, 32, 1960, 1065 - 1071 (As cited in Nickerson, 1975).

Asp.C.W. "The effectiveness of low frequency amplification and filtered speech testing for pre-school deaf children" Final Report for B.E.H. project No.522113 U..S. Dept of Health, Education and Welfare, Washington,D.C., U.S. Govern-ment printing office (1973). (As cited in Shaddon et.al., 1980).

Bever,T.G., Fodor,J.A., "Theoretical notes on the acquisition of syntax: A critique of 'Contextual generalization' Psychol. Rev., 72, .1965. 467 - 468, (As cited in Ling, 1971).

Bloomfield,L. "Language", New York, Holt, Rhineholt, 1933.

Blumstein.S "Hemispheric processing of intonation
&
Cooper.E. contours" - Cortex, 10, 1974, 146.

Bolinger.D. (Ed) "Intonation Selected Readings" Harmonds worth, Penguin Books, 1972.

Bolinger.D. "Aspects of language", New York, Harcourt Brace Jovanovich, Inc., 1975,

Boothroyd "Concept and control of fundamental voice frequency in the deaf - An experiment using a visible pitch display." Paper presented at the International Congress on Education of the deaf, Stockholm, 1970 (AS cited in Nickerson, 1975).

Brown.B.C, "Perception of personality from speech:
Strong.W.J. Effects of manipulation of acoustical
Rencher.A.L, parameters." Journal of Acoustical Society of America, 54, 1973, 29.

Calvert.D.R. "Speech sound duration and the surd-sonant error" - Volta Review, 64, 1962, 401 - 403.

Crystal,D. "Non-segmental phonology in language acquisition - A Review of the issues." Lingua, 32, 1973, 1 - 45, (As cited in Shaddon et. al., 1980).

Delattre.P. "The distinctive function of intonation" in Bolinger.D. (Ed.) - "Intonation - Selected readings", 1972.

Denes.B.P. "A preliminary investigation of certain aspects of intonation." - Language and speech, 2, 1959, 106 (As cited in Fry, 1979).

Denes.B.P., & Pinson.N, "The speech chain - The physics and Biology of spoken language", New York, Anchor Press, 1973.

Fairbanks.G, "Recent Experimental investigation of vocal pitch in speech." - Journal of Acoustical Society of America 11, 1940, 457 - 466, (As cited in Nickerson, 1975).

Fry.D.B. "The physics of speech" London, Cambridge University press, 1979.

Gray.G.W. & Wise.C.M. "Bases of Speech (3rd ed.), New York, Harper Bros, 1959.

Green.D. "Fundamental frequency characteristics of the speech of profoundly deaf individuals.", 1956, (As cited in Ling, 1971).

Hood.R.B. "Some physical concomitants of the perception of speech rhythm of the deaf." Ph.D thesis, Stanford University, 1966, (As cited in Nickerson, 1975).

Huttazr.G.L. "Relation between prosodic variables and emotions in normal American English utterances," Journal of Speech and Hearing Disorders" 11, 1968, 48]

Jakobson.R. "Kindersprache, Aphasic and allgemeine Lautgesetze" - Uppsala universitets Arsskrift, (As cited in Lieberman, 1968).

Jones.L, "The phoneme - Cambridge, W.Heffer & sons. Ltd, (2nd ed.) 1962, (As cited in Lehiste, 1970).

Kaplan.E.L. "Therole of intonationin the acquisition of language," unpublished Ph.D dissertation, Cornell university, 1969, (As cited in Ling, 1971).

Koike.K.J. "A test of rhythm and intonation patterns for young normal hearing children" Master's thesis. University of Tennessee, Knoxville, 1977, (AS cited in Shaddon et. al., 1980).

Koike,K.J. "The test of rhythm and intonation
&
Asp.C.W. patterns; A pilot study, paper presented to the meeting of the Acoustical Society of America, Miami, Florida, 1977, (As cited in Shaddon et.al, 1980).

Kressin.L.Y., "Speech production in 2 - 3 year
Marquardt.T.P. old children - perceptual analysis
&
Asp.C.W. of selected segmental features."
Paper presented in the meeting of Acousticad Society of America, Washington.D.C, 1976, (As cited in Shaddon. et.al., 1980).

Kurath.H. "A phonology and prosody of Modern English." The university of Michigan press, 1971.

Lado.R. "Language testing - The construction and use of foreign language tests," New York, Mc Graw - Hill Book Company, 1964.

Lehiste.I. "Supra-segmentals" Cambridge, The M.I.T. press, 1970.

Lenneberg.E,.H. "Biological foundations of Language", New York, John willey and sons, 1967, (As cited in Shaddon et.al., 1980).

Leonard.L.B. "The role of intonation in recall of various linguistic stimuli." Language and Speech, 16 (4), 1973, 327 - 335.

Leon.R.P. & Martin.P. Bolinger.D. (Ed.), 1972. "Machines and measurements," in

Lewis.M. "Infant speech, A study of the beginnings of language", New York Harcourt Brace, 1936, (Ascited by Lieberman, 1968).

Lewis .M. " Infant speech, A study of the beginnings of language," - Routledge and Keganpaul (1951) (As cited by Shaddon et. al. 1980).

Lieberman.P. "Intonation, Perception and Language" Research Monograph No. 38, Cambridge, The M.I.T. Press, (1968).

Lieberman.P. & Sheldon.B.M. "Some aspects of fundamental frequency and envelope amplitude as related to the emotional content of speech" in Bolinger,D. (Ed.) - "Intonation - Selected Readings" 1972.

Ling, D. "Speech and the Hearing - impaired child: Theory and Practice - 3417, Volta Place, N.W., Washington D.C. 20007, U.S.A., The Alexander Graham Bell Association for the Deaf Inc. 1971.

Mallard,A.R. & Danilaff,R.G. "Glottal cues for parent judgement of emotional aspect of infant vocalizations". Journal of Speech and Hearing Research 16(4), 1973, 592 - 596.

Manjula.R. "Intonation in kannada - some aspects" Unpublished Master's dissertation. University of Mysore, (1979).

Martony.J. "On the correction of the Voice pitch level for severely hard of hearing subjects" American Annals of the Deaf, 113, 1968, 195 - 202, (As cited in Nickerson, 1975).

Menyuk.P. "The Development of speech" - Bobbs - Merrill, 1972, (As cited by Shaddon et al., 1980).

vNickerson.S.R. "Characteristics of the speech of the deaf persons." - Volta Review, 77 (6), 1975, 342 - 358.

Ostwald.P.F. "Sound makings The Acoustic communication of emotion." - Springfield, Charles.C.Thomas, 1963 (As cited in Lieberman, 1968).

Phillips.N.P., Remillard.W, Bass.S. & Pronovost.W. "Teaching of intonation to the deaf by visual pattern matching." American Annals of the Deaf, 113, 1968, 239 - 246, (As cited in Nickerson, 1975).

Pike.E. "Controlled infant Intonation" in Adon and Leopold (Eds.) - child language - A book of readings, Englewood cliffs, Prentice Hall, 1971, 102 - 204.

Pike.L.K. " Genera1 characteristics_o£ Intonation" in Bolinger.D., 1972.

Pollack, Rubenstein & Haronitz. "Coramunication of verbal modes of expression" - Language and Speech 3, 1960, 121.

Rubeinstein.B. "Unpublished memo. Seizure clinic, Coney Island Hospital, New York, (As cited in Lieberman, 1968).

Safer.M.A. & Leventhal.H. "Ear differences in evaluating emotional tones of voice and verbal content." J.Exp.Psychol: Hum, Percept, Perform 3(1), *1911*, 75 - 82, (As in DSH XVII(3),1977,328)

Schafer.P. "Beo bachtungen und versuche an cinem kinde" - z.Pad.Psych, in Lewis (1936 111 - 116, (As cited in Lieberman 1968).

v. Shaddon.B.,Asp.C.M., Tonkovich.D.J., & Mason.D. "Imitation of suprasegmental pattern by 5 years old children with adequate and inadequate articulation" Journal of Speech and Hearing Disorders, 45(3), 1980, 390-491.

Smith.F. & Goodenough.C. "Effects of context, intonation and voice on the reaction time to sentences." - Language and Speech, 14, 1971, 241-250, (As cited in Ling,197]

Sorenson.J. "Fundamental frequency contours in the speech of deaf children." Term paper, M.I.T., 1974, (As cited in Nickerson, 1975).

Stratton.D.W. "Intonation feedback for the deaf through a tactile display" - Volta Review, 76 (1), 1974, 26 - 35.

Sussman.H.M. Hernandez.M.A. "Spectrographic analysis of the supra-segmental aspects of the speech of hearing impaired adolescents" - Audiol. Hear. Educ. 5 (4), 1979, 12 - 16, (As cited in DSH XX(2), 1980, 206).

Templin.M. "Norms on a screening test of articulation for ages three through eight" - Journal of speech and Hearing disorders , 18, 195?, 323 - 331 (As cited in Shaddon,etal, 1987

Tokova.R.V. & Yampblskaya "Development of speech intonation in infants during the first to two years of life." (As cited in Manjula, 1979).

Voelker.C.H. "A preliminary Stroboscopic study of the Speech of the deaf" - Journal of Acoustical Society of America, 35, 1963, 1876 - 1877.

APPENDIX

The 2 stories used to elicit speech samples from the subjects.

1. SImha maθu IlI

Onð Sala SImha malkondIθu. āga Onð IlI banðu aðar maI mɛlɛ Odādakɛʃuru mādθu. SImhake θumba sIt banðu IlIn hIdkond hɛlθu - "e nInn3n θInð hākbIdθIn nodu". āga IlIgɛhɛðrIkɛ āgI "SImha n3nn3n bItbIdppā, nIg kaʃta banðāg nān kandIθa sahaja madθInI", 3nθa hɛlθu. SImha hoglI 3nθa bIdθu. Inonð ðIna SImha balɛlI sIk hākondbIdθu. āg IlI banðu balɛnɛla kadɛð hakI SImhan bIdIsθu.

Translation of the above story;~

The lion and the rat:-

Once a lion was sleeping. At that time a rat started running on its body. The lion got very angry. It caught hold of the rat and said, "I will eat you up." The rat got scared and said, "Please let me go: when you; are in trouble, I will defenitely help you." Then the lion let it go. One day the lion was caught in a net. Then the rat tore the net and set the lion free.

2. Kāgɛ maθu narI

Onð ðIna Kāgɛgɛ θumba hasIva gIθu. aðakkɛ onð rottI tʃ'ur sIkθu. Kāgɛ aðan nodI, "eʃ'tu ðod rottI tʃuru!" 3nθa kʰuʃI jāgI bājal katʃ'kondu marað mɛlɛ hogI kuθkondθu. Iðan nodI onð narI- "ā rottI tʃuru nanag bɛku" 3nθa anðkondu marað k3lag banθu. kāgɛn nodI- "kāgɛ rādjā nin eʃ't tʃɛnāg hād hɛlθIja nanagonð hād hɛlθIja?" 3nθa kelθu. kāge djambaðInða djorāgI baI θ3g3ðu- 'kā - kā' 3nθa kugθu. āg rottI tʃuru k3 lag bIθu. narI aðan θogond od hojiθu. Kāgɛ- "ajo nanag θInak enu Illa," 3nθa alak ʃuru mādθu.

The Crow and the Fox

One day a crow was very hungry. It found a piece o£ bread. The crow felt very happy. It said, "What a big piece of bread!" and happily took it and sat on a tree. *A* fox saw this and thought, "I should take that piece of bread," and went near the tree. He asked the crow, "You sing very well. Will you please sing a song for me?" The crow was flattered. It opened its mouth and start calling "Ka - Ka" loudly. The bread piece fell down. The fox took it and ran away. The crow felt very sad and said/ "I don't have anything to eat," and started crying.