

INTONATION IN TELUGU - SOME ASPECTS

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ALL INDIA INSTITUTE OF SPEECH AND HEARING

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May - 2000

Dedicated

TO

My Parents and teachers

CERTIFICATE

This is to certify that this dissertation entitled "**INTONATION IN TELUGU - SOME ASPECTS**" is the bonafide work in part fulfillment for the degree of Master of Science (Speech and Hearing) of the student with register number M - 9816.

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This is to certify that this dissertation entitled "**INTONATION IN TELUGU SOME ASPECTS**" has been prepared under my supervision and guidance.

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DECLARATION

This dissertation entitled "*INTONATION IN TELUGU - SOME ASPECTS*" is the result of my own study under the guidance of **Dr. N.P. NATARAJA**, professor and Head Department of Speech Sciences, All 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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Table of Contents

(Page No.)

I.	INTRODUCTION	1-7
I.I.	REVIEW OF LITERATURE	8-62
I.I.I.	METHODOLOGY	63-72
IV.	RESULTS AND DISCUSSIONS	73-124
V.	SUMMARY AND CONCLUSION	125-128
VI.	BIBLIOGRAPHY	129-134
vī.I.	APPENDIX-A	

B

LIST OF TABLE AND GRAPHS

GRAPH:	PAGE NO.
1. Intonation pattern in Fear	78.a
2. Intonation pattern in Anger	83.a
3. Intonation pattern in Joy	88.a
4. Intonation pattern in Neutral	92.a
5. Intonation pattern in Grief	96.a
6. Intonation pattern in Frustration	101.a
7. Intonation pattern in Worry	105.a
8. Intonation pattern in Surprise	109.a
9. Intonation pattern in Jealousy	113.a

TABLE	PAGE NO.
1. Number of sentences selected for each of the Nine Emotions and the sex of the speakers.	
..1,1 (Fo-V) and (Io-V) in fear	75-76
2.1.2 Frequency range in Fear	77
2.1.3 Intensity range in Fear	77
2.2.1 (Fo-V) and (Io-V) in Anger	79-81
2.2.2 Frequency range in Anger	81-82
2.2.3 Intensity range in Anger	81-82
2.3.1 (Fo-V) and (Io-V) in Joy	84-85

2.3.2	Frequency range in Joy.	86
2.3.3	Intensity range in Joy	86
2.4.1	(Fo-V) and (Io-V) in Neutral	89-90
2.4.2	Frequency range in Neutral	90-91
2.4.3	Intensity range in Neutral	90-91
2.5.1	(Fo-V) and (Io-V) in Grief	93-94
2.5.2	Frequency range in Grief	95
2.5.3	Intensity range in Frustration	95
2.6.1	(Fo-V) and (Io-V) in Frustration	97-98
2.6.2	Frequency range in Frustration	99-100
2.6.3	Intensity range in Frustration	99-100
2.7.1	(Fo-V) and (Io-V) in Worry	102-103
2.7.2	Frequency range in Worry	104
2.7.3	Intensity range in worry	104
2.8.1	(Fo-V) and (Io-V) in Surprise	106-107
2.8.2	Intensity range in Surprise	108
2.8.3	Intensity range in Surprise	108
2.9.1	(Fo-V) and (Io-V) in Jealousy .. .-	110-111
2.9.2	Frequency range in Jealousy	112
2.9.3	Intensity range in Jealousy	112

3. Intonation patterns under various emotional -
Conditions

4. Fo and Io range in various emotions and also
Comparisons of ranges between males and females.

5. Perceptual scores in percentage for different emotion
In native and non-native speakers.

INTRODUCTION

"Language is a purely human and non-instinctive method of communicating ideas, emotions and desires by means of system of voluntarily produced symbols". (Sapair, 1921). 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, syntax. Phonology is the important area of the language containing acoustical characteristics of speech. It is divided into segmental and supra segmental phonemes. Phonemes are elements common to group of sounds. Segmental phonemes are 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, 1978).

Spoken sentences are strings of segments that vary not only in spectral quality, but in fundamental frequency, amplitude and relative length. To understand what a speaker has communicated, a listener must identify the segments that is composing the utterance, and the order in which they occur, but a good deal of information is also encoded in the frequency, amplitude and timing variations, i.e., the prosody of the utterance, and listeners makes good use of it.

Prosodic processing can be so efficient that the listeners will attend to the prosodic content at the expense of semantic continuity. (Darwin, 1975).

Prosody has been viewed as decorative ornamentation, functioning to make speech more aesthetically pleasing (Freeman, 1983). Intonation is one aspect of prosody it is the salt of an utterance and without it a sentence can be understood but the message is colourless and tasteless. Incorrect use of it can lead to embarrassing ambiguities (Delattre, 1962).

Intonation, an aspect of prosody, is an important factor in normal speech. If this aspect of prosody is affected one can feel the aberration in speech. "Intonation, like everything else in language, is one instrument in an "orchestra". (Bolinger, 1972). Many times sentences spoken with inappropriate intonation does not bring the wanted effect on the part of the listener and the speaker is mis-understood. One should know different intonation patterns for different emotions before producing them.

Intonation is one of the more endearing aspects of the suprasegmentals. Bolinger (1972) stated " Intonation is the broad undulation of the pitch curve that carries the ripples of accent on its back. Sarcasm, irony and various types of humour are also dependent upon intonation changes. It is important to

emphasize that all of the consequences of prosody interact suprasegmentals like stress, rate and intonation are constantly used together in speech and combined in appropriate ways to produce the desired linguistic effect.

Bolinger (1972) stated that most important grammatical function of intonation in language is to tie the major parts together within the sentences and the sentences together within the conversation. It gives information about where the division of the sentence comes, what is subordinate to what, and whether speaker is saying, asking or commanding

People often get annoyed not by what has been said to them, but by the way it has been said, 'often people react more violently to the intonational meanings than to the lexical ones" Pike (1945). There are some researchers who claim that intonation plays only peripheral part (Bolinger, 1972), on the other hand there are those who show that intonation is the most 'central' aspect of our oral communication (Lado, 1961; Pike, 1945; Lieberman, 1962) whether it is a form of 'central' aspect of oral communication or not, has been neglected in many languages. This neglect was noticed by Lado (1961) who said that "in spite of its importance in many languages, intonation signals have been the last to be analyzed linguistically, and still remain somewhat controversial in the few languages which has been analysed. A possible explanation of this may be the fact that intonation pattern seem to be learned at the earliest stages of language

learning and are deeply embedded in the habit mechanism of our use of language.

OBJECTIVES OF THE STUDY:

1. To note the pattern of intonation in the sentences spoken by the speakers with various emotions in Telugu speakers.
2. To analyse the native and non-native listener responses to the different emotional utterances of the speakers.

NEED FOR THE STUDY:

The literature on communication disorders is filled with diagnostic description of the dysprosodic speech. Every major category of disordered speech is affected by some degree of disrupted prosody. Abnormal prosody is a primary salient characteristic of the speech of the deaf. Further, deficiencies in speech perception and production of prosodic features are present in large number of language disordered children and adults.

Speech pathologists can readily recognize dysprosody and have attempted systematic description of some abnormal dysprosodic patterns (Darely, 1979), but successful treatment methods aimed at the restoration or

establishment of natural prosody are infrequent in literature. Therefore, the study of normal prosodic aspects is essential.

Intonation plays an important role in the understanding of speech, and it is essential to know the intonation pattern of a language. This in turn helps speech pathologists to plan and execute therapy of cases, as teaching intonation is a part of language therapy for deaf and other cases.

Very few studies on intonation have been done in Indian languages and no information is available on intonation in Telugu language has not been given much attention. Thus there is a need for the study of intonation in Telugu.

HYPOTHESIS:

1. In Telugu different intonation patterns are used in expressing different types of emotions i.e.; there is fundamental frequency variation in the sentence as related to emotion expressed.
2. Intensity variations that occur in the sentence do not show difference between different types of emotions.
3. The native speakers can identify the intonation patterns better than non native speakers.

IMPLICATIONS OF THE STUDY:

1. This study provides information regarding intonation in Telugu language.
2. The procedure developed by this study can be used to study the intonation in different languages.
3. The intonation patterns identified by this study, can be used for giving therapy to speech and language disordered cases.
4. To teach intonation in deaf children.
5. For further research

LIMITATIONS:

1. Randomly selected sentences have been taken, and the number of sentences for different emotions are equal.
2. The dialogues from film stories depicting various emotions have been selected. These samples may not be equal to natural speech

3. Spontaneous speech not considered in the study and no comparison was made between the intonation patterns in spontaneous speech and the sentence selected from the audio-tapes of film stories.
4. Synthesized speech was not used so the intonation patterns of the test sentences were not isolated from the other prosodic variables.

REVIEW

Speech is a form of language that consists of sounds produced utilising the flow of air exhaled from the lungs. Speech is an established communicative system of arbitrary and conventionalized acoustic symbols, produced mainly by the action of muscle of the lower respiratory and upper respiratory tracts (Travis, 1971).

Speech is a form of communication by which transmission of information takes place by means of sound waves which are in the form of acoustic energy (Fant, 1975). It is the man's primary method of communication, evolved by man. By its great flexibility, it permits man to produce a variety of signals to commensurate with the richness of his imagination. At the same time, the ability to think in terms of purposiveness and causality enables man to expand enormously his use of reciprocal communication for the coordination of social activities. (Eisenson and Irwin, 1963).

Functions of speech.: Speech is produced without observable effort by the human beings. The range of speech variation is immense, and yet considered normal. It gives different information's, about the specific character of the vocal tract of the speaker, which enables one to recognize speaker's voice, physical well being and emotional stated attitude towards the entire context in

which the speech event occurs. It can also carry other information about speaker with reference to the conventions of social class occupation and style. Prosody has been viewed as decorative ornamentation functioning to make speech more aesthetically pleasing (Freeman, 1983). Intonation is one aspect of prosody. It is the salt of an utterance without it, a statement can often be understood, but the message is tasteless, colourless. In correct uses of it can lead to embarrassing ambiguities (Delattre, 1960).

Need for good speech: The literature of communicative disorder is filled with diagnostic description of dysprosodic speech. Every major category of disordered speech is channelled by some degree of disrupted prosody. Abnormal prosody is a primary salient characteristics of the speech of the deaf. Further deficiencies of speech perception and production of prosodic features are present in large number of language disordered children and adults while speech pathologists can readily recognize dysprosody and have attempted systematic description of some abnormal dysprosodic patterns (Darley, 1975). Intonation plays an important role in understanding the speech, it is essential to know the intonation patterns of a language. This will in turn help speech pathologists to plan and execute therapy for cases. Teaching information is a part of language therapy for deaf and other cases.

When one analyses good speech, the speech that most adequately contributes to social interaction, it is discovered, that it possesses certain characteristics. Each of these characteristics makes its peculiar contribution to the total impression. Some of these important characteristics of speech are loudness pitch, intonation and inflection, rhythm, voice quality, articulation, stress, accent style, level of language, kind of language.

Loudness: Loudness is , in general, the psychological correlate of intensity. The term refers to the "strength of the sensation received through the ear". This is measured in terms of phones and sones.

Pitch: The pitch is yet another important characteristic of speech. For every voice there is a general pitch level known as optimum pitch at which the voice will be found to be most comfortable or most effective. This level will vary from person to person and each person will find it easily possible to make a considerable number of variations from this general level. The normal range of pitch variations depends upon sex, age and several other factors. The voices of men are generally lower in average pitch than those of women. Under conditions of excitement, many people have voices which break or show pitch breaks.

Intonation or inflection: are two other characteristics of speech which go hand in hand with pitch. Inflection is the shift in pitch during the utterance of a

syllable. There are times when it is appropriate to speak with a minimum of inflection but a person who consistently talks on a monopitch will find his listener either irritated or asleep. A true monotonous voice is comparatively rare, but it dominates any conversation by its difference.

Articulation is a series of overlapping ballistic movements which places varying degrees of obstruction in the path of the outgoing air stream and simultaneously modifies, the size, shape and coupling of the resonating cavities (Nicolasi, Harryman, and Krescheek, 1978).

Articulation in the simplest form, is a modification of the interrupted air stream (Voiced or unvoiced) into different sounds by the movement of articulators such as tongue, lip, jaw, teeth, soft palate etc. Articulation is said to be normal as long as the speech sound produced by the speaker is conveying the meaning intended by him.

Normality and abnormality are variable terms which depend on various factors such as the background and experience of the speaker and listener, the geographic location, the age and other factors.

Stress and accent are two other characteristics of speech to be considered. When certain syllables in polysyllabic words are given an extra stress then it is known as accent. Accent is primarily a matter of convention; it is concerned with correctness in word pronunciation.

Projection is another characteristic of good speech. Projection arises in part from a good voice mechanism, used properly. Projection is to make the voice easily audible to all listeners without apparent expenditure of unnecessary effort. But mere loudness does not of itself constitute projection. Failure to provide an adequate breath stream to activate the vocal bands with sufficient force may be a cause of poor projection. Good speech must be more than merely audible; it must be intelligible as well. Adequate projection contributes to both of these desired effects.

The peculiar combination of all the above mentioned characteristics of speech give rise to the final characteristic of speech, namely, style, which is unique for each person. Every individual has a style of speech which is unique and this is due to his peculiar combination of all the characteristics of speech.

Prosody or suprasegmentals are properties of speech, that have a domain larger than a single element. As Pisoni and Sawusch (1975) suggest "Prosody may serve as the interface between low level segmental information and higher

levels of grammatical structures in speech. Haggard (1975) elaborates on this interface role of prosody stating that, "Prosody carries direct phonetic cues to certain semantic and grammatical classes; It therefore serves to restrict the search processes, whereby contact is made between cognitive representation and acoustic representation. Prosodic or suprasegmental features are linguistic abstraction, which exist in the mind of the linguistically competent speaker-listener. The four supra segments are stress, intonation, juncture and rhythm. Stress refers to the accentuation or emphasis, laid on syllable or word. Intonation refers to variations in pitch as a function of time. Juncture refers to the boundaries between the phonological units, signalled by segmental modifications Rhythm, in the conventional usage, refers to the pattern of accents/stress on a string of syllables. In general, it has been agreed upon, that there exists some rhythm in speech and that it gives; a shape to a sentence, an idea of the length of a sentence and melody. It also marks the beginning and ending of a phrase and helps in memorizing a particular prose or poetry and leads to the ease of pronunciation.

^

The crucial event essential for voice for voice production is vibration of vocal cords. It changes DC air stream to AC air stream. Converting aerodynamic energy to acoustical energy. From this point of view the parameters involved in the process of phonation can be divided into three major groups.

1. The parameters which regulate the vibratory pattern of vocal folds.

2. The parameters which specify the vibratory pattern of the vocal folds.
3. The parameters which specify the nature of sound generated.

Hirano (1981) has further elaborated on this, by stating that, "the parameter which regulate the vibratory pattern of the vocal folds can be divided into two groups: Physiological and Physical. The physiological factors are succinctly put, related to activity of the respiratory, phonatory, and articulatory muscles. The physical factors include the expiratory force, the conditions of vocal folds and the state of the vocal tract. The expiratory force is the energy source of phonation and is regulated chiefly by the respiratory muscles and the state of the broncho pulmonary system and thoracic cage. The condition of the vocal folds which are the vibrators is described with respect to the position shape, size, elasticity and viscosity of the vocal folds. It is influenced by the activity of laryngeal muscles and pathological conditions of the vocal folds and the adjacent structures. The state of the vocal tract, the channel between the glottis and lips affects the vibratory pattern of the vocal folds to a certain extent and it is regulated chiefly by the articulatory muscles.

These primary physical factors in turn determine certain secondary features, which include the pressure drop across the glottis, volume velocity or mean air flow rate, and glottal impedance. These secondary features are referred to as the aerodynamic parameters.

Vibratory pattern of the vocal folds can be described with respect to various parameters including the fundamental frequency, regularity of periodicity in successive vibrations, symmetry between the two vocal folds, uniformity or homogeneity in the movement of different points within each vocal fold, glottal closure during vibration, amplitude of vibration, speed of excursion, wave which travels on the mucosa, contact area between the two vocal folds, glottal area wave form and so on. The nature of sound generated is chiefly by the vibratory pattern of the vocal folds. It can be specified both in acoustic terms and in psychoacoustic terms. The psychoacoustic parameters are naturally dependent upon the acoustic parameters. The acoustic parameters are, fundamental frequency, intensity, wave form or acoustic spectrum, and their time-related variations.

Hirano (1981) has pointed out that the acoustic analysis of the voice signal may be one of the most attractive methods for assessing phonatory function or laryngeal pathology because it is non-invasive and provides objective and quantitative data. The technique of acoustic analysis has promising future as a diagnostic tool in the management of voice disorders. Many acoustic parameters, derived by various methods, have been reported to be useful in differentiating between pathological voice and normal voice. Hirano (1981) goes on to say that all the previous reports are preliminary reports and that further

extensive basic and clinical research is require in order to obtain some algorithm for diagnostic purpose.

When vibrating, the vocal folds provide a wide range of quasi periodic, modulations of the air stream accounting for various tonal qualities, reflecting the different ways the vibrator behaves(Brackett, 1971). The essential function of larynx has been widely accepted, but the controversy arises regarding the way the vocal cords are set into vibration. There are mainly two theories of phonation namely:

- a. Myo elastic aerodynamic theory
- b. Neurochronaxic theory

Muller in 1843 first advanced the myo elastic aerodynamic theory. Tandrof (1975) and Smith (1984) suggested few modifications. This theory postulates that the vocal folds are set into vibration by the air stream from the lungs to the trachea and the frequency of vibration is dependent on their length, tension and mass. These are regulated primarily by the interplay of the intrinsic laryngeal muscles.

Husson (1950) postulated that each new vibratory cycle is initiated by a nerve impulse transmitted from the branch of the vagus nerve. The frequency of

vocal cords are dependent upon the rate of pulses delivered to the laryngeal muscles.

According to Fant (1960), the mechanical myoelastic theory of voice production is commonly accepted. Based on the myoelastic theory, he considers the following factors as responsible for determining frequency of vibration of vocal cords.

1. Control of laryngeal musculature affecting the tension and mass distribution of the cords. Increase in tension and decrease mass increases fundamental frequency.
2. Decrease in subglottal pressure decreases the fundamental frequency.
3. Increased degree of supraglottal constriction as invoiced consonants reduces the pressure drop across the glottis, thus reducing the alternating positive and negative pressure and thus reducing the fundamental frequency.
4. A shift in the tongue articulation towards the front position results in an increase in fundamental frequency due to increased vocal cord tension.

The sounds produced by the vocal fold vibration do not themselves constitute the voice. It will be inaudible and nonhuman in quality and consists of fundamental tone and rich supply of over tones. Only when it's a particularly resonated and intensified by the vocal tract, do they constitute the human voice in terms of speech output most of the times.

Prosody of speech embraces all the variations of pitch, time and loudness introduced by the speaker in order to emphasize word and syllables and make his/her speech interesting. (Darley, 1975). Prosody has been viewed as decorative ornamentation, functioning to make speech more aesthetically pleasing. Prosody functions as the foundation of structural support for the organisation of speech communication (Freeman, 1983). Although much of the message in speech is conveyed by the segmental phonemes, additional information is carried by the prosodic features. (Anisworth, 1976).

Prosodic features may extend over varying domains. Some times over relatively short stretches of utterances, like one syllable or one morpheme or one word and sometimes over longer stretches of utterances, like one or phrase, or one clause, or one sentence. Intonation is relatable to longer stretches of utterances (Cruttenden, 1986).

Prosody of connected speech may be analyzed and described in terms of the variation of large number of prosodic features. There are however, three features, which are most consistently used for linguistic purposes, either singly or jointly. These three features are pitch, length and loudness. Pitch concerns or the varying height of the pitch of the voice over one syllable or over a number of successive syllables; length concerns the relative duration of a number of successive syllables or the duration of a given syllable in one environment relative to the duration of the same syllable in another environment. Loudness concerns changes in loudness of the syllable or the relative loudness of a number of successive syllables. At linguistic level, speech can be viewed as organized by stress and intonation into suprasegmental units. This is the organisation format for normal speech production and this organization significantly facilitates perception of the speakers "message". (Harris, 1978).

Voice is one component of speech. Human voice is an important vehicle for communication and intrinsic linguistic and grammatical features of stress and intonation in speech and voice are exclusively human attributes (Greene, 1964). Voice has been defined as " the laryngeal modulation of the pulmonary airstream, which is further modified by the configuration of the vocal tract", (Brackett, 1971). The production of voice is a complex process. It depends on the synchrony between the respiratory, the phonatory and the resonatory system which in turn requires precise control by the central nervous system.

Intonation is an exclusive term referring to pitch as a function of time may be applied to a simple inflection or to long term variations in phrases over numerous inflectional shifts (Greene, 1964).

"Intonation", like everything in language, is one instrument in an orchestra". (Bolinger, 1972). It is the variations of pitch as applied to the whole sentence. Bolinger (1972) considers intonation as only a "peripheral part of the oral communication". According to Bolinger (1972), "Intonation is not as 'central' to communication as some of the other components of language. If it were, we could not understand some one who speaks in a monotone, and in so far as our comprehension of written language is due to its being a faithful reproduction of speech, we could not read".

Denes (1959) states that "the phonemic sequence is not the only linguistic form, in which information to be transmitted by speech, factors like intonation, stress and rhythm also make their contributions. Recognition of these factors will not only provide the listeners with additional information about the speaker's intention but, because they help to indicate the speaker's line of thought, they will also affect phoneme recognition." He also writes that intonation is the linguistic form by which the speaker's emotional attitudes are conveyed such as doubt, agreement, questioning, affirmation, continuing interest etc.

"Intonation is the linguistic form in which the speakers organize certain kinds of information" : (Denes, 1959). "Intonation is the perception of changes in the fundamental frequency (Fo) of vocal cord vibration during speech production" (Minifie, 1973). The acoustic cues for prosodic features which have received the most extensive attentions are fundamental frequency, intensity and temporal spacing of acoustic events.

Steele, (1965) was the first who worked on elusive side of spoken language and set it down in a clear and systematic visual form and gave it peculiar symbols. He called these missing components, melody and measure. Now-a-days melody is being called intonation by phoneticians. Fry (1968) suggest that in the analysis of language structure, the phonological level must be separated from the prosodic level and the resulting phonemic string only serves as a vehicle for prosodic elements. The differences in sound quality which forms the basis of the phonemic system constitutes the fundamental contrastive elements of language and it is the prosodic features whose contrastive function embraces these different phoneme strings. In some natural languages, it is the differences of intonation and rhythm that decides intonation and rhythm that decides the prosodic features and in a few languages like Burmese Vietnamese the differences in voice quality also have a linguistic function in determining the prosodic features. According to Pisonic and Saweesh (1975),

"Prosody may serve as the interface between low level segmental information and higher level grammatical structures in speech." Later this interfacing role of prosody was elaborated by stating that "Prosody carries direct phonetic cues to certain semantic and grammatical classes."

Prosodic features including intonation, rhythm and stress fulfill important functions in speech perception and production. Perceptually, prosodic information assists the listener in segmenting the flow of speech by contouring words. Syntactically, prosodic features help differentiate among different patterns. Lexically, prosodic features aid in differentiating grammatical categories such as verbs and nouns. In addition, prosodic features also relate to specific pragmatic functions. For eg; contrastive stress is used to distinguish between topic and comment (Chafe, 1970). He also added that it is used to distinguish new and old information in discourse. The new information is generally stressed while the old information is not. Bolinger (1972) explained the linguistic stress function to set off elements which carry a heavier information load and which the speaker wishes to place into focus. During speech production speaker can speak rapidly and carelessly stress on unstressed elements controlling on careful articulation on only critical elements.

Another major function of stress is to indicate the syntactic relationship between words or parts of word. There are many noun-verb opposition in English.

The placement of stress indicates the syntactic function of the word. Similar opposition occur in cases where two word phrases form compounds such as "a walk out", " to walk out". In these cases, there is a stress only on the first element of the compound for the nouns, but on both elements for the verbs.

Amplitude modulation is manifested in language by what is most commonly termed as stress. It has however been observed that what is interpreted by the speaker or hearer has no simple correlation with loudness. Stress is marked by alternations of pitch, loudness, tempo and perceived segment duration.

For the comprehension of speech, not only discrimination of consonants are necessary, but also cues like stress and inflectional patterns, the melody of the language are necessary, which are compared against the fixed patterns that have been learned. Stress, intonation and inflection are the aspects which denote the variations in pitch continued with the other attributes of voice like loudness and time (Greene, 1964). Variations in pitch of speech are mainly instrumental in the expression of logical aspect of meaning. They also contribute significantly in the expression of emotional meaning. It was found by careful experimentation that both experienced and inexperienced speakers use the widest inflection for 'anger¹ and the narrowest for 'grief. One might almost say

that excitatory emotional states express extremely narrow variations (Gray and wise, 1959).

Stress in speech is dependent upon increase in breath force or a fuller use of resonances. Inflection is accompanied by minute adjustment in length and tension of the folds which produce expressive pitch glide. The meaning of speech is purely dependent upon the factors of stress, pitch , or pace, which are conceived intellectually as rhythmic sequence of events or coherence of what would otherwise be the utterance of a disconnected series of vowels and consonants (Winckle, 1970). Rhythm in speech is a pattern of vocal change, draws attention to the need for regular lung ventilation or breathing pattern which underline pauses, stress, rate, pitch or intensity. Refers to the relative stress of syllables in a word. Rhythm also plays an important role in speech.

An extensive cross sectional study was conducted by two Russian investigators, Tokova and Yampolskaya (1969), using 170 infants upto two years. It was found at about the first month of life, children reacted to disagreeable situation (Hunger, Pain) and announced it with a peculiar variation of pitch in the cry. During the second month sounds of happiness and the laughter appeared during the third month. Therefore until the sixth month, the semantic content of the speech, sounds was confined to these four forms

discontent, placid cooing, happiness, laughter, although the number of speech sounds increased.

During the second half of the year, the intonational capacities were further augmented. The important observation made was that the new forms of intonational expressions appeared at greater intervals from third month onwards. Exclamatory delight, with a calmer, satisfied sound were not differentiated from the intonation of happiness until the sixth month. A request intonation developed from the seventh month and a question intonation did not appear until the second year. The above studies show the importance of intonation in the expression of emotions in speech in as young age as few months. Barry (1981) regarding the functions of prosody states that:

1. The prosody has a guide function, i.e., it helps the hearer
 - a. To extract the relevant signal from the noise
 - b. To direct the hearers attention to the most important element of an utterance.

2. It divides longer sentences into smaller units

3. It signals the information focus of a sentence and with a tonal accent on one of the words in the unit

4. It expresses the interactional role of an utterances with in a complex sequence
5. It indicates the speaker's attitude

The acoustic cues for prosodic features which have received the most extensive attention are fundamental frequency, intensity and temporal spacing of acoustic events (most frequently expressed as duration and rate measurements). These cues may carry segmental information also. Bolinger (1972) states that "the rise and fall in the fundamental frequency is not only thought of as a grammatical signal of completeness and incompleteness but also as emotional gauges of tension and relaxation. It becomes essential to differentiate intonation from the 'tone' of a tone language. In tone languages, pitch contours are located on single syllables and not on groups of syllables or on an entire sentence as in intonation. These words cannot exist until their phonemic tone exists along with its sounds. Tone also carries the basic lexical meaning of the word.

It is a well known fact that intonation patterns are acquired by children even before the actual acquisition of speech sounds. The shift of intonation as a meaningful speech signal that has a reference to specific social situations was comparatively rapid. Lowenfeld (1927); Buchler and Hetzer (1928) reported that infants from the age of 2 months onwards, responded positively to the human

voice, while infants from the age of 3 months onwards responded positively to friendly tone and negatively to angry tones of voice.

In a study conducted by Corlew (1968), to know the development of the recognition abilities of intonation contours in English, two series of experiments were conducted. These two series investigated the information conveyed by intonation from speaker to listener. A multiple choice test was devised to test the ability of 48 adults to recognize and label intonation when it was separated from all other meanings. Nine intonation contours whose labels were most agreed upon by adults were each matched with two English sentences (one with appropriate and one with inappropriate intonation and semantic content) to make a matching test for children. The matching test was tape recorded and given to children in the first, third and fifth grades. (32 subjects in each grade). The first grade children matched the intonation with significantly fewer sentences than either the third or fifth graders. Some intonation contours were matched with significantly greater frequency than others, the performance of the girls were better than that of the boys on an 'impatient' question and simple command' which indicated that there was a significant interaction between sex and intonation. The supra segmental features act as direct bridge to meaning, revealing as they do the attitudes and feelings of the speaker in ways the segmental information alone can never do. The use of changing F_0 , perceived as the pitch pattern or intonation contour of phrase/sentence is particularly effective

in expressing difference in attitudes and also difference in meaning. American English sentences are often characterized by a rise-fall intonation curve. The pitch rises during the first part of an utterance and falls at the end. This is generally the declarative sentences and of questions which are impossible to answer with 'yes' or 'no'. Another intonation curve common in English is the end of utterance pitch rise. Pitch rise indicates a question to be answered with 'Yes' or 'No'. It may also indicate that the sentence is incomplete (Lieberman, 1980). Rising intonation results chiefly from increased cricothyroid muscle activity, lengthening the vocal folds for faster vibration. Falling intonation accompanies the decrease in intensity at the end of the breath group. The decrease in subglotal pressure is accompanied by both intensity and F_0 declines. This pattern is called *an unmarked breath group*. (Lieberman, 1980).

Intonation marks syntactic contrasts, changes meaning and signals, attitudes and feeling. Excitement, including some kinds of anger and states of enthusiasm is often accompanied by large shifts in intonation, with calm, subdivided states, including some forms of grief, anger, peacefulness and boredom, characterized by a narrow range of intonation variation.

Perception of the prosodic aspects takes place by tracking the fundamental frequency and thereby perceive significant changes in fundamental frequency (F_0) resulting in various intonation contours. Listeners perceive the

proper fundamental frequency even when it is absent, as long as they can hear the harmonic structure, formed by multiples of the F_0 (Fry, 1978). To perceive the prosodic feature of stress, listeners apparently use frequency, intensity, and duration as perceptual cues. Fry (1978) has stated that the fundamental frequency is the most powerful cue to stress. The prosodic features of juncture can be cued by silence, vowel lengthening, or by features such as presence of voicing or aspiration.

Intonation groups align with larger syntactic constituents and most commonly it corresponds with clauses. But very often they also correspond with adverbials which are modifying the whole clause. Different descriptions of intonation have emphasized grammatical meanings, attitudinal meaning and discursal meanings. Emphasising grammatical meanings suggests that there are typical tones associated with syntactic structure like declaratives, interrogative and imperatives; and that the discursal meanings usually associated with these structure that is statements, questions, and commands will also have typical tones even when they are not marked syntactically. A discursal approach to the meaning of tones deals in concepts like shared mutual knowledge of speaker and listener, the desires of the speaker to dominate listeners and sort of expectation which a speaker has about a listener's reply (Cruttenden, 1986).

The linguistic features of intonation are determined by factors like the fundamental frequency intensity and duration. Most of the investigators refer to the fundamental frequency 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, 1961).

Pike (1945), while describing the role of fundamental frequency says that "every sentence, every word and even every syllable is given some pitch when it is spoken". Even a sound is produced at certain pitch level. The changes in pitch which occur within a sentence are either semi-standardized or standardized, so all speakers of the language use basic pitch sequences in similar ways under similar circumstances. However, it is difficult to analyze the language of a native speaker in order to find organization and rules in terms of pitch variation." According to Pike (1945) and Lado (1961) the variations in fundamental frequency is the basis for various intonation contours. This above statement was not found always true according to Denes (1959) and the support for this statement was obtained from the whispered speech. 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 information that is normally considered to be obtained in the form of intonation.

The acoustic cues for prosodic features which have received the most extensive attention are fundamental frequency, intensity and temporal spacing of acoustic events (most frequently expressed as duration and rate measurements). These cues may carry segmental information also. The acoustic cues of fundamental frequency (F_0) and intensity have been experimentally demonstrated to be closely related to perceptions of pitch and loudness. While F_0 and intensity are independent acoustic events in both production and perception, they are intimately linked. For example, in production, the rate of vocal fold vibration (F_0) is determined by glottal state (including degree of constriction and vocal fold tension) and by the transglottal pressure differentiated. Rate of vibration can be altered. By increasing or decreasing subglottal air pressure and by increasing or decreasing supraglottal air pressure.

In general, while speakers can, and sometimes do vary F_0 and intensity independently, there is a strong tendency for changes in one parameter to be accompanied by some change in the other. For example, while increasing vocal intensity, most speakers also rise F_0 . Poor speech motor control is characterized by limited ability to vary these parameters independently, but trained speakers can produce precise independent variations. Fundamental frequency (F_0), is a stronger cue than intensity also tends to be used in conjunction with other cues and is in most circumstances a sufficient but not a necessary cue. In general the F_0 contour of a simple, declarative sentence or clause shows a F_0 peak on the

first stressed syllable, with a gradual decline of F_0 and the final syllable of the utterance group. Faster, shorter rises and falls in F_0 occurs during overall falling contour and coincides with the production of syllables perceived as stressed. Acoustic studies have shown that major clause and phrase boundaries of a variety of sentence type are typically characterized by a fall-rise pattern (Cooper and Soreson, 1977). The lowest point in the F_0 fall occurs just prior to the syntactic boundary. The F_0 rise may begin either just before the boundary or just after the boundary.

Series of experiments were conducted in order to see the relationship of intonation with as many different kinds of acoustic characteristics as possible. In these experiments speech analysis and speech synthesis methods were used and the analytical experiments were concerned with measuring the changes that occur in the acoustics characteristics of the speech wave when the various 'tones; of intonation are spoken. The aim of the synthesis experiments was to see the kind of intonation recognized by the listeners when they hear synthetic sound generated according to various pre-determined patterns. It was found that simple relationships existed between intonation and fundamental frequency - a straight forward fall in frequency for a falling "tone" or a simple rise in frequency for a rising intonation "tone". There was a rise for rising "tone" and a fall in fundamental frequency for a falling tone.

When the intensity graphs were inspected it was found that on many occasions the shape of the intensity - time curves were similar to the fundamental frequency time curves. The exception was the high-rise "tone for which two curves were consistently different. Also, the intensity curves always started and ended at zero while the frequency would start and end at any value. These effects would probably be less pronounced in speech over longer duration than when syllables are considered. A study done by Denes (1959) confirmed that the movement of the third formant was related to the changes of intonation pattern.

Liberman and Michaels (1962), conducted an experiment to note the importance of the fundamental frequency and amplitude in intonation. Pitch pulses were electronically derived from the utterances of three male speakers of American English. They were asked to read eight neutral test sentences in certain "emotional" modes for example : a question, an objective statement, a fearful utterance, a happy utterance etc. Recordings of these were presented to separate groups of native listeners who categorized the emotional modes in forced judgement tests. Results of the tests showed that with unprocessed speech, the listeners were able to correctly identify the emotional content 85% of the time. When only pitch information was presented, correct identification was made 44% of the time. When amplitude information was added to the pitch information, the identification rose to 47%.

Mallard and Daniloff (1973) have stated that "if infant's vocalization can be categorized on dimension of emotional content ranging from euphoric laughter- (pleasure) to extreme distress, then it is likely that the infants laryngeal mechanism supplies the acoustic cues, which listeners use to identify the emotional 'meaning' of the cries. Their results 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 to rate the vocalization as distressed also increased. The investigation concluded that "glottal frequency may be crucial parameters in an infants signalling his emotional state to a listener parent."

Ross and Daffy (1973), conducted a study to find out which portion of the frequency curve contained sufficient prosodic features for listeners to correctly identify the intended emotions of speaker. An actor and actress simulated intended emotions with the same passage in each of the different spoken paragraphs. The passage was edited from the tape (thus keeping the lexical information constant) and presented to listeners under five listening conditions:

- i) No filtering
- ii) 600Hz low pass frequency filtered
- iii) 450Hz low pass frequency filtered
- iv) 300Hz low pass frequency filtered
- v) 150Hz low pass frequency filtered

The results showed that the intended emotion of a speaker could be identified with perception of only the lower audible frequencies of speech.

Various studies have demonstrated that pitch of voices carries emotional and attitudinal information (Fairbank s, 1940; Uldall, 1960; Lieberman and Michaels, 1962 ; Scheaver, 1979) and as a part of the more general feature of voice quality, serve as a social and regional marker (Trudgil, 1974). Researchers have shown that F_0 is dynamic and provides important cues regarding the emotional state, type of speech activity, race, sex and physical maturity of the speakers. It has been shown that different emotional states produce distinctive difference in F_0 's (William and Stevens, 1972), Mean F_0 is higher for reading than speaking (Hollien and Jacksoni ,1973).

Expression of emotion is highly vocal, six primary emotions-fear, anger, joy, sadness, surprise and disgust are all expressible vocally. Intonation is described as the patterned variation of pitch over linguistic units of different length. The changing F_0 perceived as the intonation contour of a phrase or sentence is particularly effective in expressing differences in attitude and meaning. Study conducted by Hulten (1968), showed correlation between the acoustic variables and degree of emotion. Degree of perceived emotions was found to be highly positively correlated with F_0 range and intensity range.

Physiological correlate of rising intonation was shown by Liberman (1967). He claimed that rising intonation resulted chiefly from increased cricothyroid muscle activity lengthening of vocal folds for faster vibrations. Changes in pitch according to Woolbert (1977) carried significant emotional information, for example, the widest ranges were usually seen in anger and narrowest in grief.

The intonation contours occur in various forms in different linguistic contents. At the elemental and segmental levels, namely the phonemes and words, one finds enough support in the literature which points to the more or less consistent fractures of F_0 (Lehiste and Peterson, 1961; Silverman, 1986). This however does not remain the same at phrase or sentence level (O'Shanghnessy, 1979; Umeda, 1981).

The declination phenomena of F_0 in discourse was accepted as a universal phenomenon by many investigators (O'Shanghnessy, 1979; Umeda, 1981).

Proponents of "rise-fall" dichotomy view (Lehiste and Peterson, 1961; Mohr, 1971, Abramson and Lisker, 1985) claimed that the F_0 fell after voiceless stops but rise after voiced stops. They also stated that the direction of post release F_0 was contextually invariant. The "Fo rise" view (Silverman, 1986) on the other hand claimed that the onset frequency of post release F_0 was raised after all stops, if they were phonologically voiced. According to his view, F_0 contour was a combination of segmental perturbation added to the smooth

underlying intonation contour, i.e.; the direction of post release F_0 depended not only on segmental phonetic features but also on the prosodic structure (Silverman, 1986).

In one of the experiments by Denes (1959), a Vocoder was used. A Vocoder is an analysis - synthesis telephone system in which a simplified version of the speech wave is transmitted. The output consisted of a sound wave with a spectrum that in broad outline corresponded with the spectrum of the speech wave produced by the speaker. This spectral pattern could be excited at will with a periodic or a noise source, producing either voiced speech or whisper, and when present, the fundamental frequency of the output could be controlled separately. The vocoder was used in the following ways:

- a) The output was permanently switched to a whisper
- b) The output was permanently switched to voiced speech, with fundamental frequency kept constant, producing monotone speech
- c) The output was permanently switched to voiced speech with the fundamental frequency varied according to some arbitrarily determined pattern. For eg. The speech input consisted of a word pronounced on a falling intonation and the pattern of fundamental frequency variation of the output was given a rising or a rising -falling pattern.

The input consisted of mostly words and very few sentences which were pronounced by expert phoneticians in a number of different tones i.e., high-fall, low-fall, high-rise, low-rise, fall-rise and rise-fall. The corresponding output of the Vocoder, which was adjusted in turn to all three conditions outlined above, was then interpreted by a few phonetically trained listeners. The results showed that listeners had little difficulty in distinguishing the intonation "tones" when the Vocoder was switched to whisper. The intonation was largely lost when monotone was used and the experiment was inconclusive when the Fo pattern of the output was varied arbitrarily. In ancient Sanskrit literature, it is said that different types of intonation should be used in different situations (Savitri, 1978). "It is said that intonation will always be made high, excited and faster in a rejoinder, confusion, harsh approach, representing sharpness and roughness, agitation, weeping, threatening, terrifying and calling one at a distance."

Intonation will be grave and slow in conditions of sickness fever, grief, hunger, thirst, deliberation ,deep would from a weapon, communicating, confidential words and in states of anxiety. Intonation will be grave and fast in women's soothing children, panic and attack of cold. Intonation will be shown, excited and of low pitch in following an object lost after being seen, hear in anything about desired object or person. Communicating something desired, mental deliberation, envy, anything which cannot be adequately expressed, telling stories, rejoinder, conclusions misery, grief, surprise, jealousy, anger, joy

and lamentation. Grave and slow intonation can be used in words containing pleasant sense and bringing in happiness. Excited and high intonations can be used in words which express sharpness and roughness.

According to Fry (1968) any spoken message consists of a series of different stresses and the succession of these stresses make up a rhythm pattern. It is said that it is difficult to distinguish between rhythm and intonation, but one can find pairs of sentences which are similar in rhythm but differ in intonation and also vice-versa. Ladefoged (1967) conducted a study by asking the subjects to read a series of phrases with both falling intonation and a rising intonation and studied the relation between subglottal pressure and stress. He has concluded that there is a greater intonation rise in the question forms and a large increase in subglottal pressure accompanied this intonation rise, As a result, the final unstressed syllables in question forms had higher subglottal pressure than the previous stressed syllable.

In an experiment Majewski and Blasdell (1969) used synthetic fundamental frequency contours. The synthetic fundamental frequency contours were classified by Polish and American English listeners as indicating either statements or questions. Graphic analysis were applied to listener's responses, in order to isolate the most prominent fundamental frequency cues that served to differentiate statements from questions. Comparison between the response

distributions for the two language groups revealed both common and language specific cues for fundamental frequency contour identification.

"Infant vocalisation, convey measuring to the parent who hears them." Has been supported by Lownfeld (1927), Buhler and Hetzer (1928), Seldlokova (1964). In a study concerning recognition of infant vocalizations, Illingsworth (1955) noted that mothers in maternity wards of a hospital claimed that they awoke when their own infant cried but not when other children cried. The purpose of the study by Mallard and Daniloff (1973). Was to determine which acoustic parameters were important to a mothers judgement of her child's vocalization along a "pleasure-distress" perceptual dimension, 24 vocalization 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, where as duration and intensity were of lesser importance. As the fundamental frequency increases the tendency to rate the vocalization as distressed also increase. The authors concluded that "glottal activity, particularly glottal frequency may be crucial parameter in an infants signaling his emotional state to a listening parent." It is well known that intonation and stress, both of which are primarily glottally mediated, are rather well developed before the first word is spoken. It seems likely that a child uses the laryngeal system, in the early

stage because it is better controlled and more highly developed than the articulatory system (Sheppard and Lane, 1968).

Rathna, Nataraja and Samuel (1976) conducted an experiment to study the identification of intonation with reference to content. They have concluded that the listeners were not able to identify the correct pair of intonation sentences and content sentence. It was also concluded that it is possible to use a similar kind of intonation pattern in different contents in Kannada language. Thus, the reference context may become important in identifying the intonation.

Manjula (1979), studied intonation in Kannada under nine emotional conditions using 36 sentences. She has concluded that "the sentences in Kannada with emotion are expressed with a final fall in the intonation pattern." A sentences with a specific emotion can be expressed with more than one type of intonation pattern; and a single intonation pattern may be used to express sentence with different emotions. Nataraja (1982) compared the intonation contour in four Indian languages (Kannada, Tamil, Gujarati, Hindi) under five emotional conditions (a) Anger, (b) Joy, (c) Jealousy, (d) Neutral, (e) Mercy. He concluded that " same intonation may be used to express different emotional conditions and further, the same patterns/contours are seen across the languages being used." There seems to be common or 'universal' intonation contours across the languages studied.

Stress may be defined as the perception of some linguistic units as emphasized or prominent in contrast to surrounding units (Freeman, 1983). Units of phonological syllable word phrase, clause, sentences or paragraph length may be stressed in contrast to surrounding speech. Stress is marked by alteration of pitch, loudness, tempo and perceived segment duration, while increase in pitch and loudness are most frequently used to mark stress, sharp decreases will also signal stress. In contrast, only slower tempo and longer perceived duration will mark stress. As might be expected increase in F_0 , intensity and segment durations have been found to accompany or cue stress (Fry, 1958), longer silent periods (pauses) may also mark and/or cue stress.

Stressed or accented syllables are perceived as louder longer and higher in pitch than unstressed syllable. Rules for syllable stress in English are exceedingly complex. At unit levels stress serves the universal purpose of marking that which is important or essential to the understanding of message. In production, this would allow the speakers to concentrate on careful articulation of critical elements. Perceptually the listener could reduce the processing load by ignoring (or only minimally attending to) the unstressed elements which the speaker has marked for him as redundant (since their identity can be deduced from the remaining stressed elements).

Pitch is one of the most important of several auditory cues for the perception of stress in standard Copenhagen Danish (Thorsen, 1978). Investigations of Rathna, et. al., (1982), showed that a relative increase in intensity, steepness of the intensity rise, a pause before the word and a large duration of the word are the features observed contributing to stress in Kannada Language.

It is true to some extent that some of the intonation characteristics are shared by most of the languages in the world. This is called universality of intonation. Though many investigators were taken up by investigators of many investigators were taken up by investigator of various corner of the world, comparing one language with the other, a definite and conclusive result could not be derived regarding this aspect. There are some, who argue in favour of it and there are some others who argue against it. Abe (1955) compared the system of English and Japanese and found similarities in the use of question and statement tunes. This was attributed to the 'universal nature' than to chance and concluded that these constitute human speech.

Bolinger (1972) states that there are three features of intonation which have similar uses in all languages. They are:

1. *Range* - The range conveys emotion when we are excited our voice extends its pitch upwards. When we are depressed we speak almost in a monotone.

As this feature is not usually under voluntary control; it is another instance of instinctive gesture.

2. *Direction* - usually connected with pause. The two together are the punctuation marks of speech. The tendency in all languages, in making statements, is to have a fairly high pitch toward the beginning of a sentence and then to drift down to the lowest pitch at the end. In questions that are answered by 'Yes' or 'No', the direction often tends to be up all the way. In both cases what is incomplete goes up and the completion comes down, an alternating tension and relaxation that again is basically gestural.
3. *Relative height* - it is associated with importance given to a particular word or words in a sentence.

Bolinger (1972) tried to reason out the causes for these universal features. According to him, there is no possibility of linguistic inheritance, since it is a kind of gesture. Intonation is gestural in some respects because a downward dip of pitch is accompanied by a submissive or placating bow of the head. It is also connected with the physiology of speech and with the nervous system in general. The universal lowering of pitch toward the end of unexcited discourse results automatically from running out of lungpower. Subglottal pressure rises and lower pitch, other things being equal. The universal raising of pitch for question

and other Keyed-up utterances is probably due to higher nervous tension in the body as a whole, which has the local affect of tensing the vocal cords.

An utterance may convey different meanings due to the changes in intonation even though the utterance contains the same segmental phonemes. The intonational meanings of a language are superimposed upon lexical meanings. Every word in a language has some intrinsic meanings. These intrinsic meanings are called lexical meanings. These lexical meanings are indicated by the consonants, vowels, stress and to some extent, the context where such a meaning is possible. The intonation meaning is a temporarily added form or transitory pitch contour. It does not contribute to the intrinsic meaning of a word but merely gives a shade of meaning added to or superimposed upon the intrinsic level meaning according to the attitude of the speaker.

Uldall (1960) states that "attitude measurement" which seemed to be promising technique by which to attempt to find out whether a group of subjects from the same linguistic community would agree on the "meanings" of intonations, and whether some few very general dimensions of meaning in the emotional area could be extracted. In her experiment, the same sentences were presented with differing intonation contour (imposed upon it synthetically) to a set of subjects who rate speech sentences plus intonation as to whether it conveyed the impression that the speaker was bored or interested, rude or polite,

agreeable or disagreeable and write down a list of 10 paired opposite on a seven point scale, using the "semantic" differential technique (Osgoods, Susi and Tannenbaum, 1957). Four sentences in English were used in this experiment and these four sentences were intended to be kept as colourless as possible so that, it would allow the intonation to add as much as possible to that, it would allow the intonation to add as much as possible so that, it would allow the intonation to add as much as possible to their meaning, so that it would represent as many situations as possible when combined with different intonations. Sixteen intonation contours were applied to these four sentences.

It was concluded that:

1. Contours of small range of frequency or small change of direction at the end are the most discussed and are often rated as being pleasant.
2. The 'smooth' contours proceeding steadily in one direction (particularly downward) are found more pleasurable than broken contours with a change of direction or movement up and down of strong and weak syllables.
3. Statements can be pleasant when either falling or rising at the end, while on the questions and the command contour final rising tends to be the pleasant ones.

4. In determining the factor of "interest" vs ' "lack of interest" the final rising or falling of the contour is not important.
5. In determining the authoritative 'submissive' factor, the range of pitch is more important than the final rise or fall.

Morse (1972) has reported high amplitude sucking experiments which demonstrate the infants between 1.5 and 2 months of age discriminate between marked (rising) and unmarked (falling) breath group intonation pattern. Martin (1980), describes supra segmental acoustic cues as functioning to 'enable the listener to expect or anticipated the rough outlines of speech not yet heard.

Rathna et al., (1975) found that a pause before a word contributes to perception of stress in Kannada language. Sorenson and cooper (1979), reported that F_0 of the first stressed syllable is higher by 6 percent for longer (13.8 word) sentences than for shorter (7.5 word) sentences. Rathna et al., (1982), did a study to find the influence of intonation patterns of part sentences on the identification of the contexts in which those part sentences are spoken. The results showed that it was not possible for the subjects to identify the correct context sentences when either only part sentences was spoken, or part sentence and context sentences was given together.

Pollack, Rubenstein and Horowitz (1960) conducted a study where four talkers instructed to read neutral sentences and sound happy or sound bored etc. There were sixteen modes of expression. Listeners attempted to identify the intended mode of expression drawing their responses drawing their responses from a limited number of alternative, Four factors on the identification of modes of expression was studied. They were:

1. The number of response alterations
2. The effect of noise
3. Whispering (to abolish speech pitch characteristics)
4. Temporal samplings

In general, it was concluded that high levels of correct recognition may be achieved for a defined small number of modes of verbal expression for a defined small number of talkers by a listening crew familiar, with the talkers mode of expression. Reasonably high levels of recognition may be achieved with sharply reduced acoustical information (low signal to noise ratios), short samples or whispered speech.

It is hypothesized that when a listener hears the first portion of an utterance he begins generating expectancies in real, based on a number of prosodic features, including tempo and rhythm. This strategy is viewed as reducing processing load and increasing processing efficiency (Freeman, 1983). Even

before an utterance begins, the listener has knowledge of the possible maximum length of the first and subsequent major constituent units, since a breath group cannot exceed respiratory constraints. After the first few syllables an individual can have even more precise estimate of the probable length of the sentence, because F_0 tends to fall rapidly in short sentence and more gradually in longer sentences.

Huttar (1968), conducted a study where in the emotional states of an adult American speaker, as reflected in 30 utterances, were evaluated by 12 subjects on a seven point semantic differential scales. The emotional states of the person whose speech was studied were measured in directly by means of listeners response and the prosodic features of the utterance were studied by two means:

1. Acoustically by means of a sound spectrography
2. Perceptually by means of listeners response

Significant correlation were found between some acoustic variables and the judgments of some types of emotions. High correlations were found between some acoustic variables and the judgement of some types of emotions. High correlations were found between the acoustic variables and judgements of degree of emotion. Correlation coefficient 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. This study presumed that the increased muscular activity associated with emotion is in some way related to an increase in pitch.

Nandini (1985), did a study to find out the kind of intonation patterns that are used by the Kannada speakers, in expressing various emotions. 30 sentences of various emotions were analyzed both perceptually and instrumentally. The results showed that:

1. In Kannada different intonation pattern are used for expressing different types of emotions
2. Terminal contours are important in determining different types of emotions
3. Pitch is important for the perception of intonation
4. The perception of pitch variations depend upon the fundamental frequency variations
5. The intonation permits the identification of emotions type of sentences even when the context sentence are not present

3. Trained judges could identify the pitch contours occurring
4. Females use larger Fo range for all emotions when compared to males

Attempts have been made to study intonation and other prosodic aspects in pathological conditions of speech.

Darley (1979), in the diagnosis of articulation disorders includes assignment of prosodic production features. He describes 'ataxic dysarthria' as association with the deviant perceptual dimension of prosodic excess and phonatory prosodic insufficiency. Acoustic analysis demonstrate that this perceptual cluster can be resolved primarily as a distortion of the temporal pattern of speech; with lengthening of normally reduced (unstressed) syllables and the occurrence of intersyllabic pauses. They suggest that ataxic speech production involves a dissociation (as opposed to integration) of the syllables, with a tendency toward equal syllable duration, frequent abnormal pause intervals between syllables. This second description is clearly a preferable basis for treatment planning, even as an articulation analysis is preferable to the observation that the client does not say all his sounds correctly. Acoustic analysis offer a access to critical diagnostic information.

Intonation problems in deaf may be divided into two major types:

- a. Monotonous voice
- b. Excessive erratic pitch variation

A comparative study of intonation pattern was done between deaf and normal hearing subjects (Nandyal, 1981). Results showed that:

1. Variation in pitch levels of hearing impaired subjects were less than that of normal hearing subjects
2. Rise and fall pattern was different for the two groups
3. The duration over which the speech segment extended was more in case of hearing impaired. It is probably due to this, the variation in intonation patterns tended to be more gradual in hearing impaired subjects and not as sharp in the case of normal hearing subjects

Kent (1979), describes three types of prosodic disturbances in neurological lesion

1. *Hyper Prosody* - Excessive or exaggerated prosody observed in some types of Aphasia and Manical states.

2. *Dys prosody* - Distorted prosody observed in cerebellar ataxia and in conjunction with some aphasia or speech ataxia
3. *Aprosody* - Attenuation, reduction or lack of normal prosody observed in Parkinsons patients and in right hemispheric lesion patients.

Blumstein and Cooper (1974), conducted two dichotic experiments to investigate the lateralization of intonation contours. Results from the two experiments suggested that the right hemisphere is directly involved in the perception of intonation contour and that normal language perception involved the active participation of both the cerebral hemispheres. Liberman (1968), comments that "although relevant phonetic or instrumental analyses are not available at present for most languages, it is possible to generalize about intonation to the extent of stating that short declarative sentence usually ends with a falling fundamental frequency contour.

In subcortical dysarthrias, Kent (1979), describes the patterns of dysprosody each representing deterioration of relative syllable timing and a distortion of Fo. 'Sweeping' is described as exaggerated Fo glides and is typical of some ataxic dysarthrias. Scanning is the marked dissociation of syllables in time. Such syllables have a marked tendency toward equal durations, and a monotypic Fo pattern. Scanning speech is characteristics of ataxic dysarthria. Very few studies are available in the area of hemisphere specialization for

intonation. Some of the acoustic correlates of intonation contours i.e, fundamental frequency and amplitude were shown to be lateralized in the right hemisphere (Day and Copeland, 1971; Goodglass and Donerfeld, 1973), the lateralisation for the intonation contours as such was not studied much.

Hird (1993) acoustically analyzed 'emotional tone' of non dominant hemisphere damaged subjects. The purpose of his study was to investigate the effect of right hemisphere damage on the perception and production of emotional prosody. Eight male patients with altered prosody following strokes in the region of middle cerebral artery of the right cerebral hemispheres and four normal subjects with no history of neurological damage participated in the study. Results showed no significant difference between the two groups on receptive scores. Right cerebral vascular accident subjects produced significantly shorter utterances than the controls in all conditions. There was also a significant standard deviation between fundamental frequency and groups.

The melodic intonation therapy for aphasias was devised by Stark (1974), based on the rationale that the intonation contours are perceived in right hemisphere. In the field of speech and hearing, knowledge regarding intonation forms a useful tool in the therapeutic work and also, to some extent in the diagnostic field. This study is an attempt to determine the intonation pattern of a

set of sentences in Telugu and to analyze the responses of a group of listeners to the emotions expressed by the speakers.

Fo in phrases and sentences

Commenting on the patterns of intonation in English. O Shangkerry and Allen (1983), observed that a typical Fo contour of an English utterance would be viewed as the composite result of a set of hierarchical patterns (associated with sentence, phrase, word and phoneme)

The Fo patterns described were as follows:

- 1) *Utterance level* - This was considered a prototypical pattern of a sentential utterance, the highest level of Fo contours which would be related to breath group effects.
- 2) *Phrase level* - A cumulative Fo pattern when the effects at the clause or phrase level were considered.
- 3) *Word level* - Depicted the additional efforts of Fo emphasis at the word level.
- 4) *Phoneme level* - A typical, complete F contour, including all levels of F efforts, the phonemic effects were manifested in the continuity break of the curve, representing unvoiced section of speech.

In other words, O' Shanh nesy and Allen (1983) stated that the sentence level determined the over all F₀ shape. They pointed that the overall pattern of F₀ in a breath group. For relatively low level, rose rapidly on the first emphasized syllable and then gradually declined to reach a very low level. In Yes/No questions, F₀ differed from the typical pattern by falling less after the initial rise and rising rapidly at the very end to the highest level in the utterance (O¹ Shanhnes5b(,1979)

With reference to phrase level, which was the second hierachial level, O' Shanhnessy and Allen (1983) agreed with Lee (1956), Olive (1975), who reported that certain points of the utterances were often marked by F₀ changes at major syntactic breaks. They further stated that within the normal gradual F₀ fall of the breath group, such breaks were indicated by discontinuous F₀ pattern, such as a sharp F₀ fall, followed by a rise on the final voiced phone before the break.

Delattre et al (1965) had pointed to the fact that this "continuation rise" F₀ pattern was used to signal to the listener that the sentence was not yet complete because F₀ fall to a low level indicated finality. The effects of modality operators such as sentential adverbs, nodals, negatives and quantifiers on a F₀ pattern. Recorded sentences and paragraphs were analysed for the F₀ feature.

It was found that the important words in each sentence were marked intonationally with rises or sharp falls in F_0 compared to gradually falling F_0 unemphasized words.

The emphasis duration were measured in terms of F_0 variations from the norm. It was found that the F_0 variations were larger.

1. In the beginning of the sentences
2. In longer sentences
3. In syllables, surrounded by unemphasized syllable
4. In contrastive contents

Other results showed that embedded clauses tended to have lower F_0 and negative contractions were emphasized on this first syllable. Individual speakers differed in overall F_0 levels. It was also seen that the F_0 of vowels changed in paragraphs, with emphasis going to contextually new information (O'Shaghnessy and Allen, 1983).

Two major differences between Yes/No questions and other sentences was studied by O'Shaghnessy and Allen (1983). These differences were:

- a. The middle of the utterances exhibited only a very slightly falling declination, with F_0 remaining above 140 Hz after the early emphasis rises.

- b. Fo increases sharply on the last word to the highest level in the utterance, rather than falling to the lowest level as in other sentences.

A series of experiments were conducted by Cooper and Sorensen (1977) to determine the extent to which speakers' syntactic loading influenced the Fo contours in the regions of syntactic boundaries. The results showed that the fall-rise patterns were more pronounced at the boundaries between two nonjoined clauses. In a study, O' Shanaghanessy (1979) examined the pattern of Fo extracted from natural speech of male speakers reading isolated sentences. Fo contour as a function of time exhibited systematic behaviour with regard to sentence type, syntactic construction and word type. He suggested that the basic Fo movements of rise - fall can be considered as the fundamental linguistic parameters which constituted the Fo feature pattern. Rise and falls, which were controlled by the speakers and perceived by the listener, were related closely with the perception of phonemes with stress, syntactic boundaries, certain phrases and sentence types (Cohala, 1970; Klatt, 1973). The level Fo (relatively flat or slightly falling Fo), rises and the fall in Fo were described as linguistically relevant Fo patterns.

Declination refers to the fact that the pitch of the voice is most commonly lower at the end of a sentence than it is at the beginning (Cruttenden, 1981). In long stretches of continuous speech, there is a global tendency for the Fo never to

decline with time, despite successive local rise and falls. (Vaissiere, 1983). This phenomenon was observed in a number of languages, in English (Magno-Caldognetto, 1978), in Italian (Fujisaki, 1979) in Japanese (Hombert, 1974).

Highlighting the general properties of Fo contours in unmarked sentences in a number of languages, Vaissiere (1983), observed some common tendencies. They are:

1. A tendency for Fo values to fluctuate between the plateau and the baseline, which delimited the speakers Fo range.
2. A tendency for the Fo range to diminish as function of time.
3. A tendency to start sentences with a large sentences initial rise in Fo, located on one of the first syllables
4. A tendency to repeat a success of Fo rises (R) and lowering (l): a pair of opposing movements indicating a prosodic word.
5. A tendency for the highest value of Fo to be located on the first prosodic word of the sentence.

Although the declination phenomenon was reportedly found in many languages, there was lack of agreement regarding the universal nature of this phenomenon in speech. Umeda (1982) tried to verify the statement that the down drift F_0 was an universal phenomenon. In a study, the F_0 of sentences in different modes of speaking i.e. short unrelated sentences, an essay and free conversation were studied, the results indicated that the F_0 pattern becomes complex as the complexity of the nontextual information increased.

It was noted that declination was observed in situations where the meaning of the sentences was not expressed well by the talker or was not specified by context or a gradual felt that "mechanical" or "bored" reading should be avoided if possible. Thus, it is noted from the literature that intonation gestures, namely rise and fall contour movement in segments differs from words to paragraphs and F_0 declination phenomenon is well noted.

Many studies have been reported on the emotive intonation patterns (Pence, 1964; Chapellez, 1964; Fo' nagy and Magdics, 1963; Manjula, 1979; Nataraja, 1985) Fo' nagy and Magdics (1963) described emotive intonation patterns in Hungarian. They concluded that:

1. Joy was denoted by an increase pitch range
2. Tenderness was expressed by a non fluctuating higher pitch level
3. Longing was denoted by a narrow pitch range

4. In case of surprise, the voice suddenly glided up or down to a high level within the stressed syllable
5. Anguish was denoted by an extremely narrow pitch range.
6. Sarcasor was devoted by a stressed syllable sliding to a low level

Nataraja (1985) found the following patterns for emotions in Kannada.

1. Joy - High - Mid - High
2. Sarcasor - Mid - Low
3. Disappointment - High - Mid - High - Mid
4. Fear - Mid low

Following are the analysis of emotion expressed in Hindi (Nataraja, 1981)

1. Anger - Mid - Low mid
2. Joy - High - Mid - High - Mid
3. Jealousy - Mid - Low
4. Neutral - Mid - Low - Low
5. Mercy - Mid - Low - Mid

The same study also analyzed the intonation pattern in other two language, the pitch pattern were as following:

Emotions	Gujarathi	Tamil
Anger	Mid - Low - High - Low	Mid- Low- Mid
Joy	Mid - Low - Mid - Low	High-Mid-High-Mid
Jealousy	Mid - Low	Mid - Low
Neutral	Mid- Low- Mid	Mid- Low- Low
Mercy	Mid - Low	Mid - Low- Mid

Thus above studies show that change in pitch have some emotional significance and it is also agreed by a number of researchers that Fo contours may play a role in the perception of intonation of sentences.

METHODOLOGY

The aim of the present study is to find the various intonation patterns, that are used by Telugu speakers in expressing different emotions. For this study it was decided to use taped audio recorded speech samples from popular Telugu films and note the following emotions.

1. Fear
2. Anger
3. Joy
4. Neutral
5. Grief
6. Frustration
7. Worry
8. Jealousy
9. Surprise

The Study was carried out in the following steps:

- a. Selection of material
- b. Preparation of material.
- c. perceptual evaluation.
- d. Acoustic analysis
- e. Relating results of perceptual evaluation with acoustic analysis.

a. SELECTION OF THE MATERIAL:

Sentences were selected from audio recordings of popular films in Telugu, which are available in cassettes. It was decided to use dialogues from audio cassettes of films on the following basis:

1. The emotions are expressed in conversation as naturally as possible.
2. The subjects depicting various emotions in films are trained subjects.
3. The emotions are conveyed by speakers to the listeners only through auditory mode, without visual cues.

Therefore, it was considered that independent variable has been operated to the maximum possible extent - specifically, the intonation has occurred in such a way so as to convey the required emotion. Hence, it was decided to select sentences from two popular movie -audio cassettes, expressing different emotions. The movies which have been considered as popular and acted by popular artists were:

1. Sankaraabhara Nam
2. CuuDaalani undi

In total thirty six sentences expressing various emotions, were randomly selected from two movie audio cassettes. These sentences were selected on the basis of emotions identified by the experimenter and three Telugu native speakers. The experimenter and the three Telugu native speakers had a mean

age of 25 years with mother tongue as Telugu and all were well versed in Telugu language. The selection was done after listening to the tapes fully i.e.; the expressed emotion was decided on the basis of context and content of the sentences.

b. PREPARATION OF MATERIAL:

Nine different emotions were considered. They were surprise, fear, joy, anger, jealousy, worry, frustration, grief and neutral. These emotions were chosen therefore they are the primary emotions, commonly used by humans and commonly conveyed in speech.

Table 1

Shows the number of sentences selected for each of the nine emotions and sex of the speaker.

Sl. No.	Emotion	No. of Sentences	Speakers	
			Male	female
1.	Fear	4	2	2
2.	Anger	4	2	2
3.	Joy	4	2	2
4.	Neutral	4	2	2
5.	Grief	4	2	2
6.	Frustration	4	2	2
7.	Worry	4	2	2
8.	Surprise	4	2	2
9.	Jealousy	4	2	2
Total No. of Sentences			18	18

Four sentences for each emotion was selected. These sentences expressed different emotions to the maximum possible extent and could be easily identified as expressing a particular emotions by the native speakers of Telugu. The sentences selected, with the emotions expressed in each sentence are given in Appendix 'A'.

These thirty six sentences selected by the Telugu native speakers, as conveying various emotions were extracted from the two audio cassettes of film (actual film cassette) to a Meltrack CR-X90 chrome precision audio cassette on a Sony Stereo Deck (CFS - W445S).

c. PERCEPTUAL EVALUATION:

" A perceptual test was done to check whether the emotions conveyed by these sentences were perceived by the native Telugu speakers. The age range of these native speakers varied from 18-35 years. The native speakers chosen had good command of Telugu language and using that for their day to day speech, the non-native speakers were never exposed to Telugu language or had contact with Telugu speakers. The subjects had no knowledge of the purpose of the study Twenty native and Twenty non-native subjects were taken among them ten males and ten female subjects each were taken.

The subjects were comfortably seated and the recorded sentences were presented to the subjects using stereo deck. A response sheet was provided to each subject and the following instructions were given.

"You will hear recorded samples of sentences spoken by different individuals, both males and females. Listen to each sentence and try to identify the emotion if not on first try, ask for a repetition. Among the various emotions given to you on the response sheet choose the one which you feel the speaker has conveyed. If you feel none of the emotions match, leave the space blank. If you identify a particular emotion write it down beside the sentence number." The subjects were given as many repetitions needed to judge the emotion in each sentence. The doubts of the listeners were also clarified as and when they asked. Then both native and non-native speakers listened to the sentences and marked the emotions that they felt they heard. Responses given by the subjects were compiled and tabulated.

Analysis of the perception part of the experiment involved the following:

1. It was studied whether non-native speakers could identify the various emotions from the thirty six sentences in a similar manner as native Telugu speakers.

2. It was also studied whether the context and the content of the sentences were important for perceiving the emotion.

d. ACOUSTIC ANALYSIS:

The tape recorded samples were analysed using the following instruments. The following setup was used for acoustic analysis.



The Fundamental frequency and intensity contours for each sentence were obtained. The frequency and the intensity of the points on the curve were determined by moving the cursor.

Analysis procedure:

The recorded sample, that is , each sentence at a time was fed through speech interface unit (12 bit A/D converter) and digitized at a sampling rate of 1600 KHz and stored on the hard disc of the computer. Before digitizing, each sample was passed through antialiasing filter at 7.5KHz with a roll off of 48 dB/octave. The level indicators of the speech interface unit was used to monitor the intensity level to avoid any distortion while digitizing the signal.

Each sentence was analysed using the software packages SSL and Vaghmi, developed by voice and speech systems, Bangalore and the fundamental frequency and intensity reading of samples were extracted. The digitized signal was displayed on the computer screen using the programme 'Fo-Int' On execution of this programme, a specified portion of the speech signal would be displayed on the monitor of the computer. A vertical cursor, which could be moved horizontally, was used to mark specific portion of the waveform, highlight and listen to the signal present in the marked portion of the waveform, and to note the time at any given point or points on the waveform using this one could segment, edit or measure the duration of any desired portion of the waveform. All the sentences spoken by the subjects of both the groups were analysed using 'display' programme.

Programme FoINT of Vaghmi software (VSS, Bangalore) was then used to extract the Fo and intensity curves for each sentence uttered by the subjects. This programme enabled simultaneous visualization of the Fo pattern for a given portion of speech signal, the intonation contours and also the waveform. A vertical cursor, which could be moved horizontally enabled marking of a particular point on the waveform, the Fo and intensity measures corresponding to this point could be noted at the point where the cursor was placed on the waveform. Averaged Fo and intensity variations were extracted and the following Fo and intensity informations were also obtained for each sentence :

1. Mean fundamental frequency (in Hz)
2. Range of fundamental frequency (in Hz)
3. Mean intensity (in dB)
4. Range in intensity (in dB)

Analysis of these samples involved the following:

1. Mean Fo for the thirty six sentences were determined.
2. Noting the individual pattern of Fo and intensity curves for each particular emotion.

3. The curves for different emotion expressed by males and females were separated. For example all the curves of sentences expressing "fear" in males were grouped together. Thus different patterns of curves produced were tabulated. Eg.-Rise-Fall-Rise etc., It was observed whether there was only one kind of pattern prevalent for a particular emotion conveyed by the Telugu speakers.
4. The frequency and Intensity at the beginning and end of each word of a sentence were noted.
5. For each sentence, the range of frequency variations were determined by subtracting the lowest frequency from the highest frequency. The average range of fundamental frequency for a particular emotion; produced by speakers of Telugu language was calculated by dividing the sum of ranges of a particular emotion by the number of a sentences chosen for each emotion. These ranges were then tabulated.

The patterns were analysed and then compared with the perceptual evaluation. Thus the identification of emotion by native and non-native speakers of Telugu, based on perceptual evaluation was obtained. The highest and lowest frequency range was 378.75 and 247.25 for the emotions anger and joy respectively. The highest and lowest intensity range was 28.5 and 15.5 for the

emotions jealousy and fear respectively. The same sentences were subjected to acoustic analysis to note the intonation curve and reference to each emotion expressed by both males and females.

RESULTS AND DISCUSSIONS

Intonation, an aspect of prosody is an important factor in normal speech. "Intonation like every thing else in a language, is one instrument in an orchestra", (Bolinger, 1972). The aim of the present study was to find out the various intonation patterns, that are used by the Telugu speakers in expressing different emotions. The intonation is analysed both perceptually and acoustically based on the fundamental frequency variations. Greene, (1964) has stated that intonation is an exclusive term referring to pitch as a function of time and may be applied to a simple inflexion or to long term variation in phrases over numerous inflexional shifts, whereas others consider that intonation is determined by factors like fundamental frequency (Fo), intensity and duration (Minifie, 1973, Lieberman, 1980; Fry, 1978; Lado, 1961; Sorenson and Cooper, 1977).

In this study four sentences for each of the nine emotions randomly selected from Telugu film audio cassettes have been analysed both acoustically and perceptually.

Table 1:Shows the number of sentences selected for each of the nine emotions and the sex of the speaker

Sl. No.	Emotion	No. of Sentences	Male	Female
1.	Fear	4	2	2
2.	Anger	4	2	2
3.	Joy	4	2	2
4.	Neutral	4	2	2
5.	Grief	4	2	2
6.	Frustration	4	2	2
7.	Worry	4	2	2
8.	Surprise	4	2	2
9.	Jealousy	4	2	2
			18	18

Total Number of Sentences = 36

Thus, thirty-six sentences, 18 spoken by males and 18 spoken by females were analysed to note the intonation patterns used in different emotions by these Telugu speakers.

The fundamental frequency (Fo) variations and the intensity (Io) variations in each sentence were obtained using "Fo- int" programme. The Fo curves and intensity curves for each emotion were obtained. The terms "steep", "gradual" and "flat" have been used to describe the intonation patterns. The concept

"steep" is used to indicate a sharp rise and sharp fall, "gradual" used to indicate a slower degree of rise or fall and "flat" to indicate small variations in Fo and intensity.

1. Fear:

Out of the four sentences depicting the emotion "fear" two were spoken by males, and two by the female speakers. The Fo and To variations of the four sentences are presented in Table 2.1.1.

Table 2.1.1. Showing Fo variations (Fo-v) and intensity variation (To-V) is "Fear" type of sentences

Sl. No.	Speaker	Sentence				
1.	Male:	చూరాలా! ఆ డెక్క బప్పుళ్ళలా కూడ కావం				
Fo-v		128-152	347-177	196-371	185-202	386-170
lb-V		32-37	42-53	52-52	49-37	36-50
		కన్నెస్తాందిరా - దవుడా!				
		203-135	132-182			
		52-47	39-44			

2. Male వద్దు నాయనా ఆల్ రెడీ ఎరిగింది కదా !

Fo-v 111-208 208-208 132-247 237-217 227-125

Io-V 40-47 47-49 49-46 47-47 48-48

3. Female: రండి వెళ్ళి పోదాం .

Fo-v 333-108 177-86 333-339

Io-V 52-51 50-44 48-38

4. Female: రాడీ వెధవలండ వచ్చుస్తున్నారండీ !

Fo-v 92-366 362-377 377-80

Io-V 50-47 48-53 52-46

The frequency range and the Io range used by the subjects in the sentences expressing the emotion "fear" are displayed in Table 2.1.2 and Table 2.1.3 respectively.

Table 2.1.2 Showing frequency range in sentences expressing "Fear".

Sent. No.	M/F	Maximum Freq.	Minimum Freq.	Range	Average Range	Range in Males	Range in Females
1.	M	473	93	380	326.5	285	368
2.	M	270	80	190			
3.	F	413	78	335			
4.	F	479	78	401			

Table 2.1.3 Showing intensity range in sentences expressing "fear".

Sent. No.	M/F	Maximum Freq.	Minimum Freq.	Range	Average Range	Range in Males	Range in Females
1.	M	53	31	22	15.5	13.5	17.5
2.	M	51	46	5			
3.	F	54	38	16			
4.	F	54	35	19			

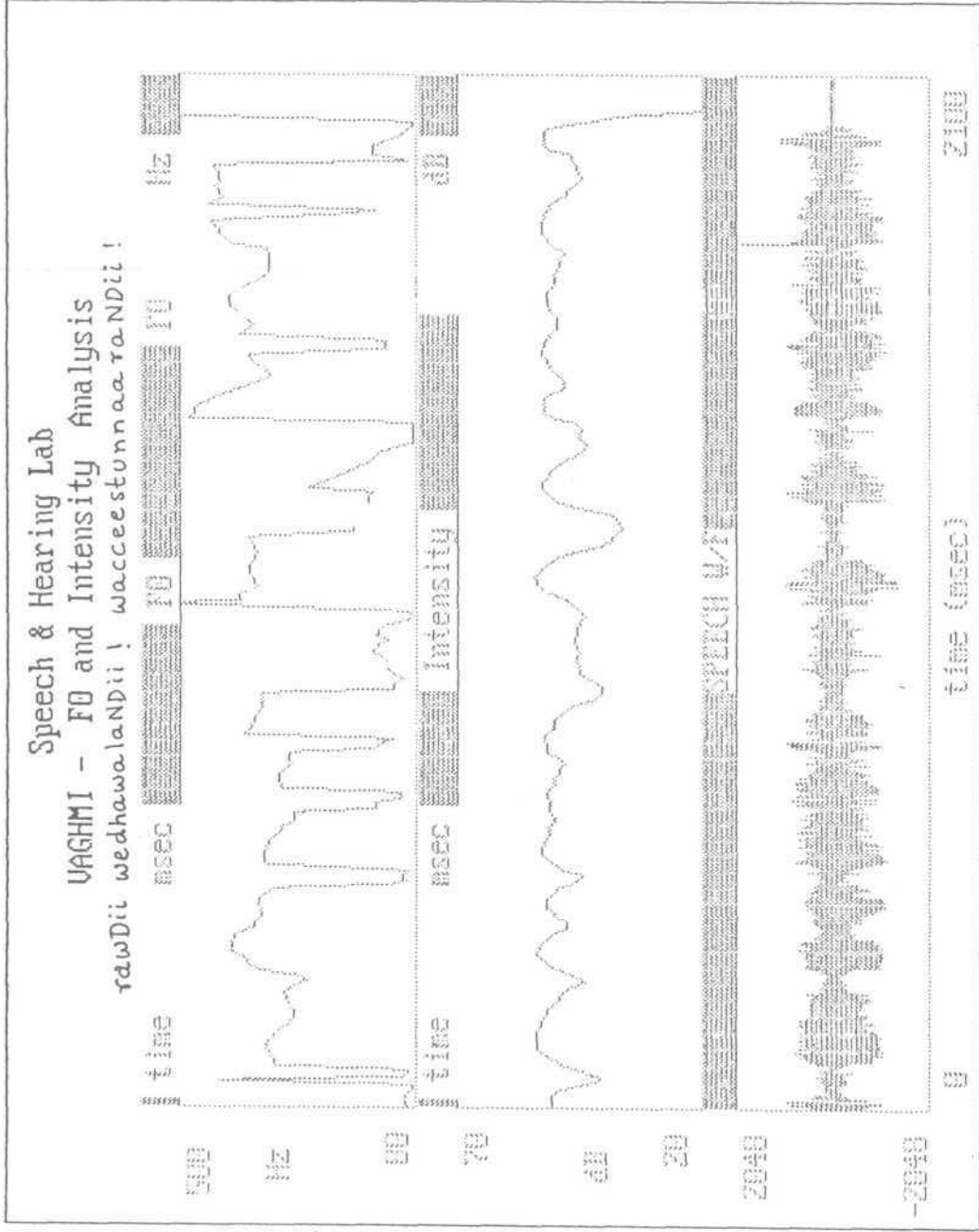
It can be seen from Table 2.1.1 that the sentences expressing "fear" in the form of statement i.e; fear statement, which is represented in the first sentence show an intonation pattern of Rise (s) -fall (g) - Rise (g) - Fall (s) - Rise (g) - Fall (g). The sentences expressing "fear" in the form of i.e. 2nd, 3rd, 4th. Refusal statement (2nd) and cautionary statement 3rd and 4th as follows:

- 2nd - Rise(s)-flat-fall (s)-R(g)-fall (s)
- 3rd - Rise (s) - fall (s) - Rise (s) - fall (g) - R(g) - fall (g)
- 4th - Rise (s) - flat - fall (g) - Rise (s) - fall (g)

The terminal contour of the fear pattern depicted rising pattern and fall in the statements form showed a falling final contour, thus terminal contour helps in determining sentence type. The To variations were in-consistent and showed decrease in energy at the end of sentence comparing Fo range and lo range in females and males it was found that the females used a greater Fo and lo when compared to males.

In general it can be concluded that both male and female Telugu speakers have used rise-flat-fall-Rise-fall, pattern in expressing the emotion fear. The study of intensity changes in each sentence shows that the variations are inconsistent. Thus no relation in terms of intensity variations could be found with the emotion expressed the study of Fo range and lo range used in expressing the emotion fear shows that females have a greater Fo and lo range when compared to males.

Graph 1. Intonation Contour : "Fear" 78.0



రాధ పెధవలండ్ వచ్చుస్తున్నారండ !

Graph-1 shows the intonation pattern of Rise-flat-fall-Rise-fall type which was used by Telugu speakers in expressing "fear"

II. ANGER:

Out of the four sentences expressing the emotion "Anger" two were spoken by males and two by the female speakers. The Fo and lo variations of the four sentences are presented in Table 2.2.1.

Table 2.2.1 Showing Fo variations (Fo-v) and intensity variations (To-V) in expressing "anger".

Sl.	No.	Speaker	Sentence			
1.	Male:		పవయ్య	గోపాలం	ఇదేమైనా	న్యాయంగా
	Fo-v		345-227	196-296	147-246	232-226
	lo-v		55-52	49-34	34-53	51-50
			ఉందా ?	ఉందా	అంటున్నాను !	
			232-132	363-306	328-174	
			49-42	53-54	54-32	

2. Male: వాడు నామాన్యడు కాదూ.

Fo-v 307-366 365-377 373-431

Io-v 52-55 55-51 50-53

3. Female: ఏం బాబూ! లక్షణంగా పెళ్ళి చెసుకా

Fo-v 372-317 494-319 282-347 351-319

Io-v 57-55 54-48 47-51 51-44

బోతున్న పిల్లని ఇలాల్పకా చ్చస్తావా!

329-373 372-373 377-83 466-399

45-48 53-52 52-55 54-56

4. Female:	ఇట్టాంట	అనాచారం	నను	విక్కడా
Fo-v	333-280	354-447	454-322	448-318
Jo-v	48-45	53-49	53-52	55-47
	చూళ్ళోదు .			
	362-418			

48-43

The frequency range and the Jo range used by the subjects in the sentences expressing the emotion "Anger" are displayed in table 2.2.2 and table 2.2.3 respectively.

Table 2.2.2 Showing frequency range in sentences expressing "Anger"

Sent. No.	M/F	Maximum Freq.	Minimum Freq.	Range	Average Range	Range in Males	Range in Females
1.	M	449	106	343	378.75	361	396.5
2.	M	474	95	379			
3.	F	494	80	414			
4.	F	504	125	379			

Table 2.2.3 Showing intensity range in sentences expressing "Anger"

Sent. No.	M/F	Maximum Freq.	Minimum Freq.	Range	Average Range	Range in Males	Range in Females
1.	M	57	32	25	17.75	15	20.5
2.	M	57	52	5			
3.	F	57	40	17			
4.	F	56	32	24			

It can be seen from Table 2.2.1 that sentences expressing "anger" in the form of questions i.e.; anger-question, which is presented in the first and third statement - showed an intonation pattern of Rise (s) - fall (g) - Rise (g) - fall (g) - Rise (s) - fall (g).

The sentences expressing "anger" in the form of statement i.e.; second and fourth showed an intonation pattern as follows:

2nd Rise (s) -fall (g) - Rise(g) - flat - fall (g)

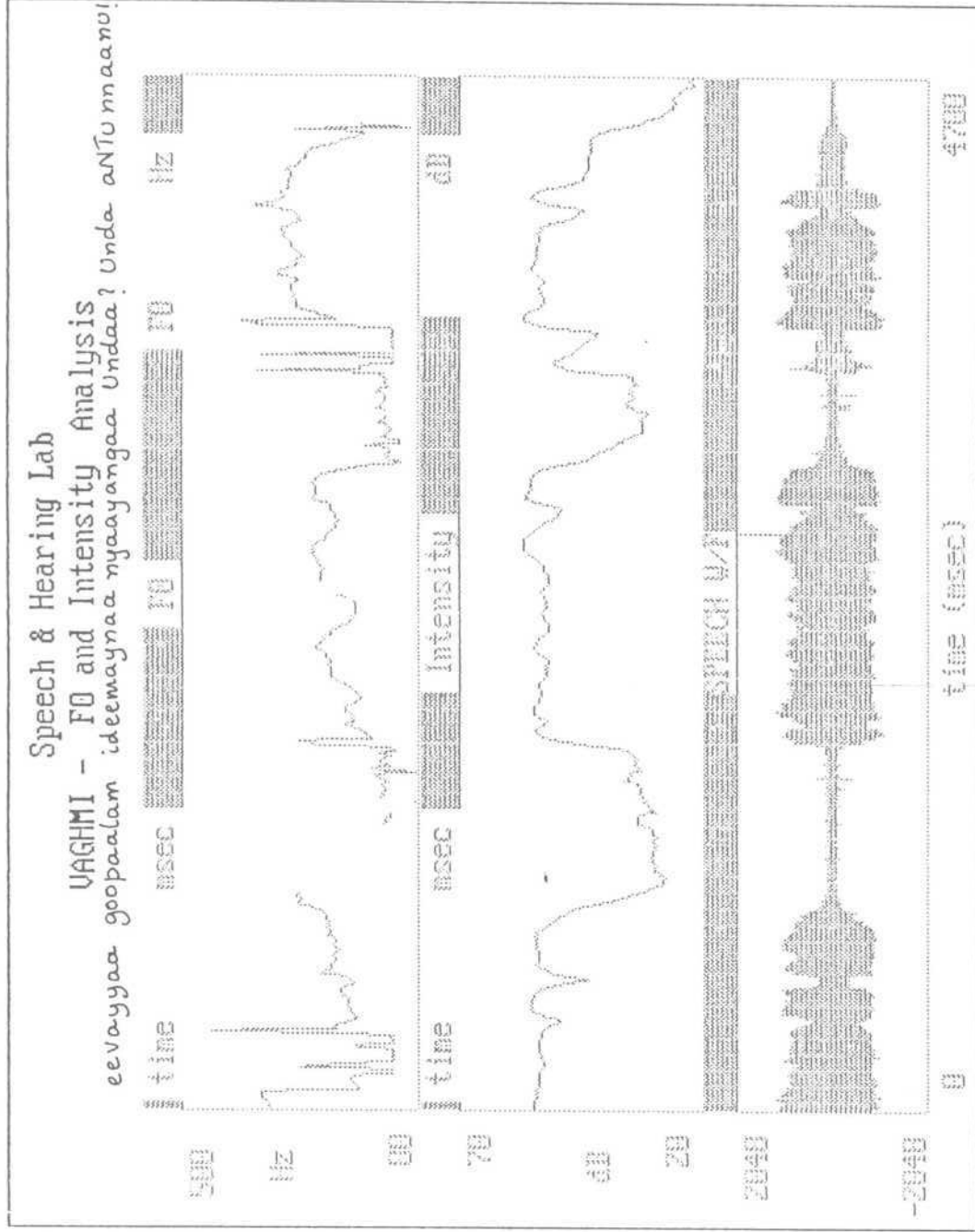
4th Rise (s) - fall(g) - flat - rise (g) - fall (g)

The terminal contour of the "anger" questions 1,3 pattern presented a rising(s) pattern where as the statement form showed gradual falling final contour, thus terminal contour helps in determining sentence type. The lb

variations were inconsistent and showed a decrease in energy at the end of sentences. Comparison of Fo range lb range in females and males it was found that the females used greater Fo and lo ranges than males.

In general it can be concluded that both male and female Telugu speakers have used rise (s)- fall(g)- fall(g)- rise(s)- fall(g) pattern in expressing the emotion anger. The study of intensity changes in each sentence shows that the variations are inconsistent, thus no relations in terms of intensity variations could be found with the emotion expressed. The study of Fo range and lo range used in expressing the emotion anger shows that males used lower Fo & Tp range than compared to females.

Graph 2. Intonation Contour : "Anger". 83.a



పవయ్య గాపాలం బదస్తైనా న్యాయంగా ఉందా? ఉందా అంటున్నాను!

Graph-2 shows the intonation pattern of Rise(s) - fall (g) - Rise (g) - fall(g) - Rise(s) - fall (g) type which was used by Telugu speakers in expressing anger.

III. JOY:

Out of the four sentences expressing the emotion "joy" have been analysed out of which two were spoken by males and two by the females speakers.

The Fo andjo variations of the four sentences are given in Table 2.3.1

Table 2.3.1 Showing Fo variations (Fo-v) and intensity variations (To-V) in "joy" type of sentences

Sl. No.	Speaker	Sentence			
1.	Male:	చాలా	చక్కగా	పాడారు	నాయనా !
	Fo-v	220-185	185-197	196-164	164-79
	Io-V	40-51	51-49	49-46	47-38

2.	Male:	బాగాసె	కనపడుతున్నావు .
	Fo-v	266-201	205 155
	Io-V	41-55	53-54

3.	Female	నా గురించి	కవిత్వం	రాశారు	తెలుసా !
	Fo-v	253-238	237-261	264-85	240-291
	Io-V	52-46	52-51	51-43	51-49

4.	Female:	నా తల్లె	రామ్మా !	రా	కూర్చా .
	Fo-v	127-395	340-244	336-121	368-296
	Io-V	52-41	35-40	41-35	35-41

The frequency range and intensity range used by the subjects in the sentences expressing the emotion joy is displayed in table 2.3.1 and 2.3.3 respectively.

Table 2.3.2 Showing frequency range in sentences expressing 'joy.'

Sent. No.	M/F	Maximum Freq.	Minimum Freq.	Range	Average Range	Range in Males	Range in Females
1.	M	220	79	141	247.25	165	329.5
2.	M	278	89	189			
3.	F	425	81	344			
4.	F	406	91	315			

Table 2.3.3. Showing intensity range in sentences expressing "joy"

Sent. No.	M/F	Maximum Freq.	Minimum Freq.	Range	Average Range	Range in Males	Range in Females
1.	M	51	36	15	18.25	14.5	22
2.	M	56	42	14			
3.	F	53	35	18			
4.	F	56	30	26			

It can be seen from Table 2.3.1 that the sentences expressing "joy" in the form of praising statements i.e, which is represented in the first two statements showed an intonation pattern of following type:

Rise (gradual) - fall (gradual) - Rise(steep) - flat - fall(steep)

The sentence expressing "joy" in the form of statement i.e. 3rd and 4th showed an intonation patterns as follows:

- Rise - fall(s) - Rise(g) - fall(s) - Rise(s) - fall(g) - Rise(g)

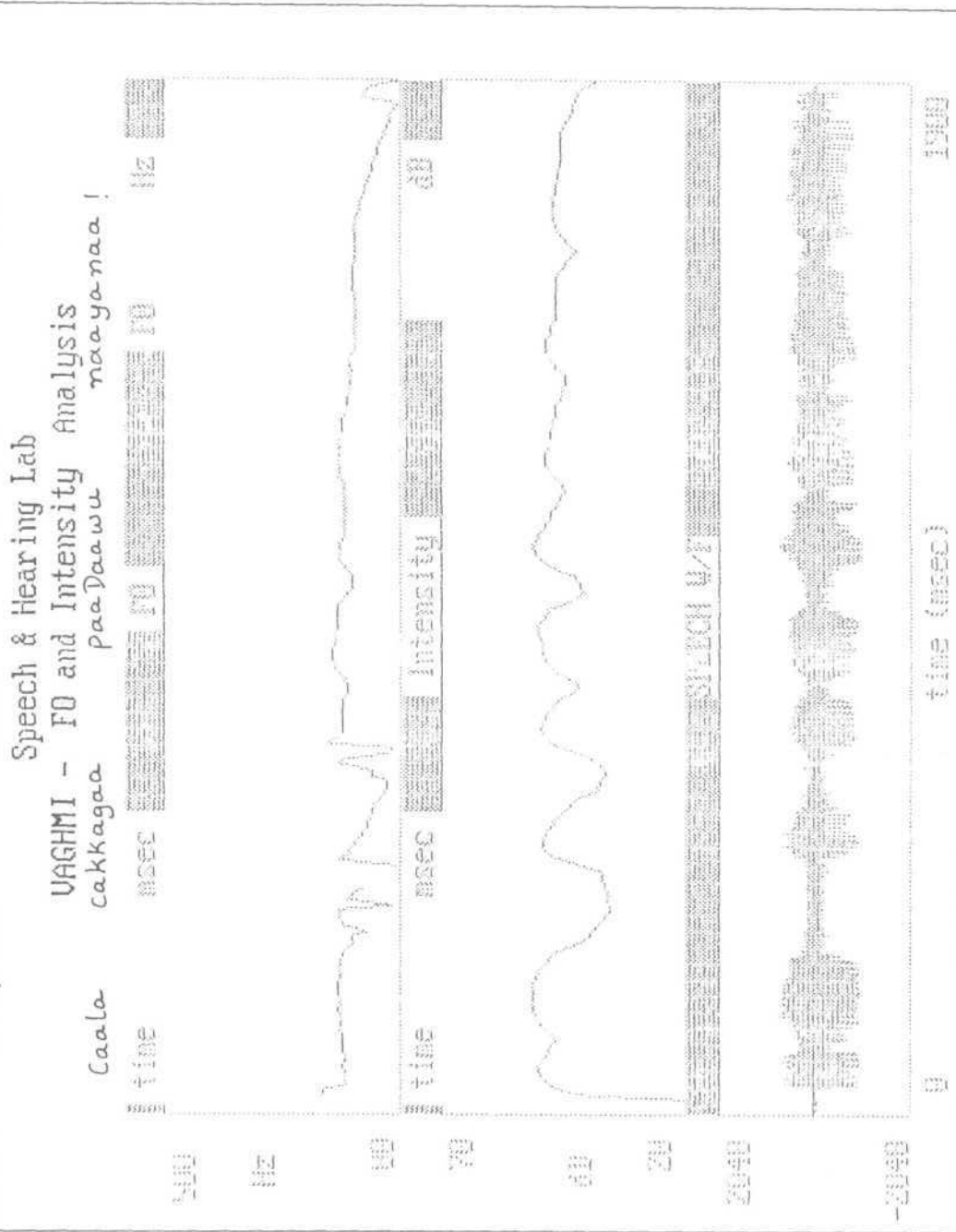
- Rise(g) - fall (g) - Rise(s) - fall (g) - Rise (s) - fall (g)

The terminal contour of the joy praising statement patterns 1 & 2 depicted a rising pattern - flat - fall(s) whereas the 3,4 statements showed Rise(s) - fall(g) - Rise(g) in final ending part of the sentence thus terminal contour helps in determining sentence type the *Io* variations were in consistent and showed a decrease in energy at end of sentences.

Comparison of *Fo* range and *ID* range shown by males and females it was found that the females used greater *Fo* and *To* range than males.

In general it can be concluded that both male and female Telugu speakers have used rise(g)- fall(g)- rise(s)- flat- fall(s) pattern in expressing the emotion joy. The study of intensity changes in each sentence shows that the variations are in consistent. Thus no relations in terms of intensity variations could be found with the emotion expressed the study of Fo range and Jo range used in expressing the emotion joy shows that females use greater Fo & lo range than compared to males.

Graph : 3. Intonation Contour : "Joy" 88.a



బాలా చక్కగా పాడవు నాయనా !

Graph-3 shows the intonation pattern of Rise(g) - fall (g) - rise(s) - flat - fall (s). Type of intonation pattern in expressing "joy"..

IV. NEUTRAL:

All of the four sentences selected to express the emotion "neutral" have been analysed out of which two sentences were spoken by males and two by females. The Fo and lo variations of the four sentences are given in Table 2.4.1

Table 2.4.1 showing (Fo-v) and (lo-V) in sentences expressing "Neutral"

Sl. No.	Speaker	Sentence			
1.	Male:	ఏ ఊరు	బాబూ ?		
	Fo-v	164-79	82-187		
	Jo-v	41-47	48-48		
2.	Male:	సందహం	లాదు	ఈడు	తెలుగాడే !
	Fo-v	114-125	136-124	142-179	172-228
	To-v	41-7	48-43	46-45	47-47

3.	Female:	అవునూ !	అర్థరాలై	ఎటో	వెళ్ళినట్లున్నారు.
	Fo-v	250-464	140-347	335-295	295-250
	3o-v	48-49	39-47	46-45	45-43

4.	Female:	ఏం	చెప్తావు	నాన్నా !
	Fo-v	348-265	261-212	203-291
	lo-v	40-44	44-49	48-44

The frequency range and the intensity range used by the subjects in expressing "neutral" is represented in Tabl3 2.4.2 and 2.4.3. respectively.

Table 2.4.2 Showing frequency range in sentences expressing "neutral".

Sent. No.	M/F	Maximum Freq.	Minimum Freq.	Range	Average Range	Range in Males	Range in Females
1.	M	444	78	366	370.75	419.5	322
2.	M	551	78	473			
3.	F	464	79	385			
4.	F	348	89	259			

Table 2.4.3 Showing intensity range in sentences expressing "Neutral"

Sent. No.	M/F	Maximum Freq.	Minimum Freq.	Range	Average Range	Range in Males	Range in Females
1.	M	50	36	14	18	14.5	21.5
2.	M	54	39	15			
3.	F	50	32	18			
4.	F	50	25	25			

It can be concluded from the Table 2.4.1 that speakers uttering sentences with emotion "neutral" showed a Rise-fall-Rise-fall intonation pattern. All the four sentences showed a final contour of a gradual fall in the Fo. The intensity variations were not consistent. However in the end of the sentences there was a decrease in the energy ie., there was a gradual fall in lo at end of all the four sentences.

Comparison of the fundamental frequency range it was found that males used a greater Fo range than females and the intensity range was found to be greater for females than males.

In general it can be concluded that both male and female Telugu speakers have used Rise - fall - Rise - fall(g) pattern in expressing the emotion neutral. The study of intensity changes in each sentence shows that the variations are inconsistent. Thus no relation in terms of intensity variations could be found with

the emotion expressed. The study of Fo range and intensity range used in expressing the emotion neutral shows that males used greater Fo range than females, and lo range was found to be greater for females than males.

Thus it can be concluded that Telugu speakers use Rise-fall-Rise-fall(g) type of intonation pattern in expressing "neutral".

V. GRIEF

All of the four sentences selected to express the emotion "Grief: were analyzed, out which two sentences were spoken by male and two by female Telugu speakers. The Fo and To variations of the four sentences are given in Table 2.5.1

Table 2.5.1 Showing (Fo-v) and (lo-V) in sentences expressing "Grief:

Sl.	No.	Speaker	Sentence			
1.	Male:		మూగవాడివి కాదు	నాన్నా!	నీకు	
	Fo-v		117-91	89-86	84-88	182-80
	To-V		42-53	52-52	53-54	54-48
			మాట	తప్పకుండా	వస్తుంది .	
			80-113	104-86	97-104	
			49-52	53-52	51-54	

2.	Male:	బాబు	పరిస్థితి	ఏమ బాగలొడు !
	Fo-v	100-157	153-100	97-88
	Io-V	54-43	46-51	52-48

3.	Female:	ఱ జనంలా	తనెలా	తప్పి పాయో డు
	Fo-v	571-146	444-425	423-92
	Io-V	46-47	47-47	47-46

4.	Female	ఇంత కింత	అనుభవించక	పోవె .
	Fo-v	302-290	309-307	302-331
	Io-V	33-48	49-37	44-36

The frequency range and the intensity range used by the subjects in expressing "Grief is represented in Table 2.5.2 and 2.5.3 respectively.

Table 2.5.2 showing frequency range in sentences expressing "grief

Sent. No.	M/F	Maximum Freq.	Minimum Freq.	Range	Average Range	Range in Males	Range in Females
1.	M	347	79	268	293	192.5	393.5
2.	M	195	78	117			
3.	F	571	78	493			
4.	F	430	136	294			

Table 2.5.3 Showing Intensity range in sentences expressing "grief

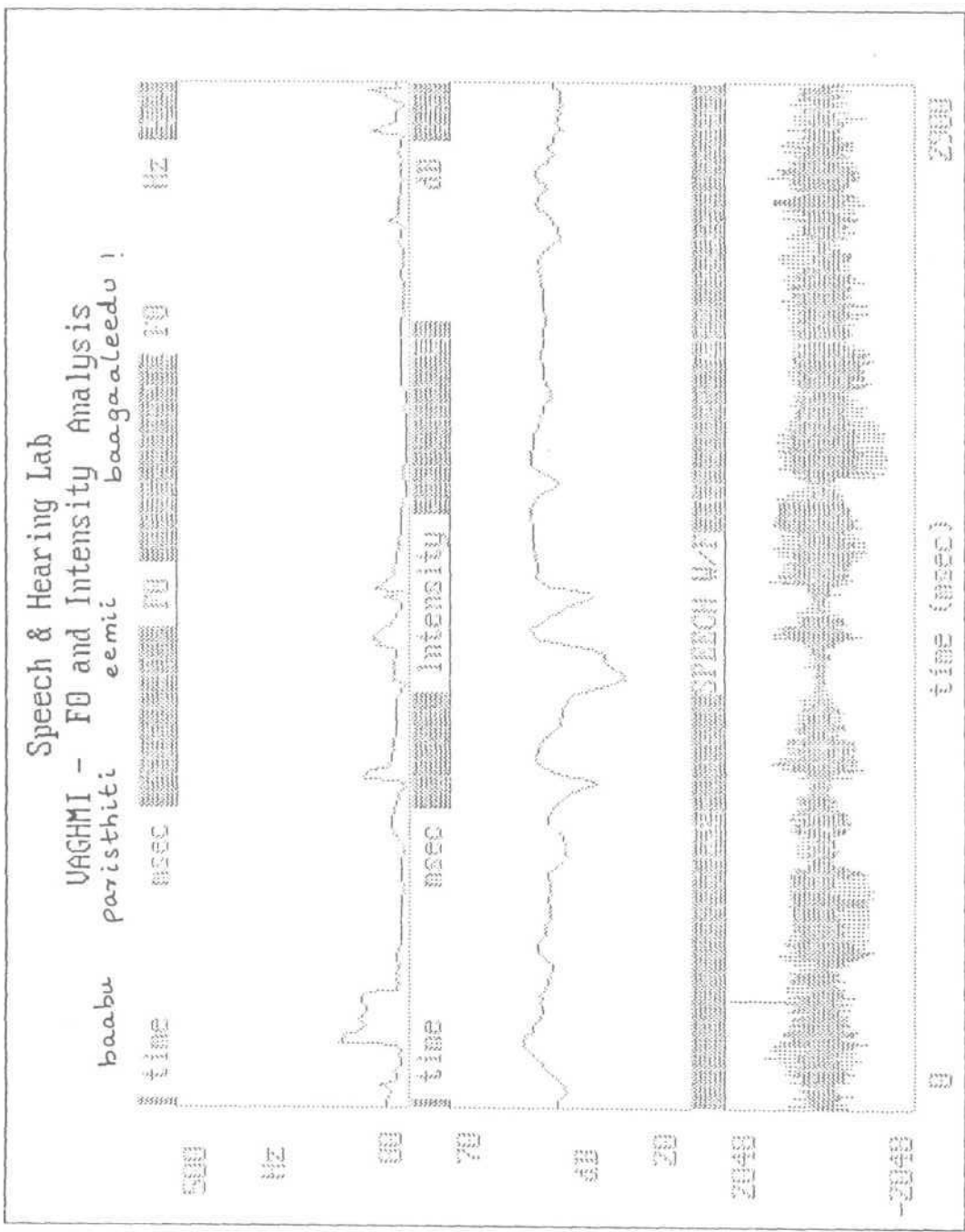
Sent. No.	M/F	Maximum Intensity	Minimum Intensity	Range	Average Range	Range in Males	Range in Females
1.	M	54	41	13	16.5	17.5	15.5
2.	M	54	32	22			
3.	F	50	37	13			
4.	F	51	33	18			

It is seen from Table 2.5.1 that Telugu speakers while expressing "grief follow Rise (s) - fall(g) - Rise(s) - flat - fall - in (1) and Rise (s) - fall (s) - flat - rise (s) - fall (s) - flat in (2), in (3) sentence the Rise (s) - fall (g) - Rise (g) - fall(g) - Rise (s) - fall (S) - Rise (g) - fall(g) and 4th sentence Rise (s) - flat - Rise (s) - fall (g) - Rise(s) - fall (g). The common pattern is the gradual falling

pattern in the terminal contour of the sentences. So far all the four sentences, the terminal contour for grief was a Rise (s) and gradual fall pattern. The intensity variations were not consistent however in the end of the sentences there was a decrease in the energy i.e., gradual fall in intensity at the end of all the four sentences were noticed. On comparison Fo-range it was found that females used greater Fo range than males, the lo-range was found to be greater for males when compared to females.

In general it can be concluded that both male and female Telugu speakers have used Rise(s) - fall(s) - flat - Rise(s) - fall(s) - flat(g) pattern in expressing the emotion grief. The study of intensity changes in each sentence shows that the variations are inconsistent. Thus no relation in terms of intensity variations could be found with the emotion expressed. The study of Fo range and lo range used in expressing the emotion grief shows that females used greater Fo range than males and lb range was found to be greater for males than females.

Graph 5. Intonation Contour : " Grief " 96.a



బాబు పరిస్థితి ఏమ బాగలేదు !

Thus it can be concluded the Telugu speakers use Rise (s) - fall (s) -flat-Rise (s) - fall (s) - flat type of intonation pattern in expressing grief, els in. Grf&f K. - 5".

VI. FRUSTRATION

Out of the four sentences expressing frustration, two were spoken by males and other two by females. The Fo and lo variations of all the four sentences analysed, are given in Table 2.6.1.

Table 2.6.1. Showing (Fo-v) and (lo-V) in sentences expressing "frustration".

Sl. No.	Speaker		Sentence
1.	Male:	ఈ బెంగాలీ	గాల తప్పింది .
	Fo-v	163-144	135-142
	Jo-V	37-50	50-49

2. Male: వమిటా కు గాల ఆయన పాలె కాదు

Fo-v 94-396 198-113 94-181 181-169

IO-V 38-49 50-32 44-39 39-32

మాట కూడో అర్థమయ్య చావదు నాకు •

80-184 166-187 385-155 299-121

37-49 46-34 46-50 50-32

3. Female: న బోడే సలహా నాకెమి అఖ్లిరెల్లదు •

Fo-v 170-403 403-350 331-166

Io-V 37-48 49-42 48-33

4. Female:	అంతుగొంతు లాని ఇంట్లో ఒక్క క్షణం కూడా			
Fo-v	198-398	376-388	369-359	359-369
To-V	36-48	48-50	50-34	35-50

ఉండలేను.

377-265

50-33

The fundamental frequency range and intensity range for "frustration" is represented in Tabl3 2.6.2. and 2.6.3 respectively

Table 2.6.2. Showing frequency range in sentences expressing "frustration"

Sent. Nso.	M/F	Maximum Freq.	Minimum Freq.	Range	Average Range	Range in Males	Range In Females
1.	M	392	78	314	397.25	331.5	463
2.	M	429	80	349			
3.	F	551	78	473			
4.	F	531	78	453			

Table 2.6.3. Showing Intensity range in sentences expressing "Frustration".

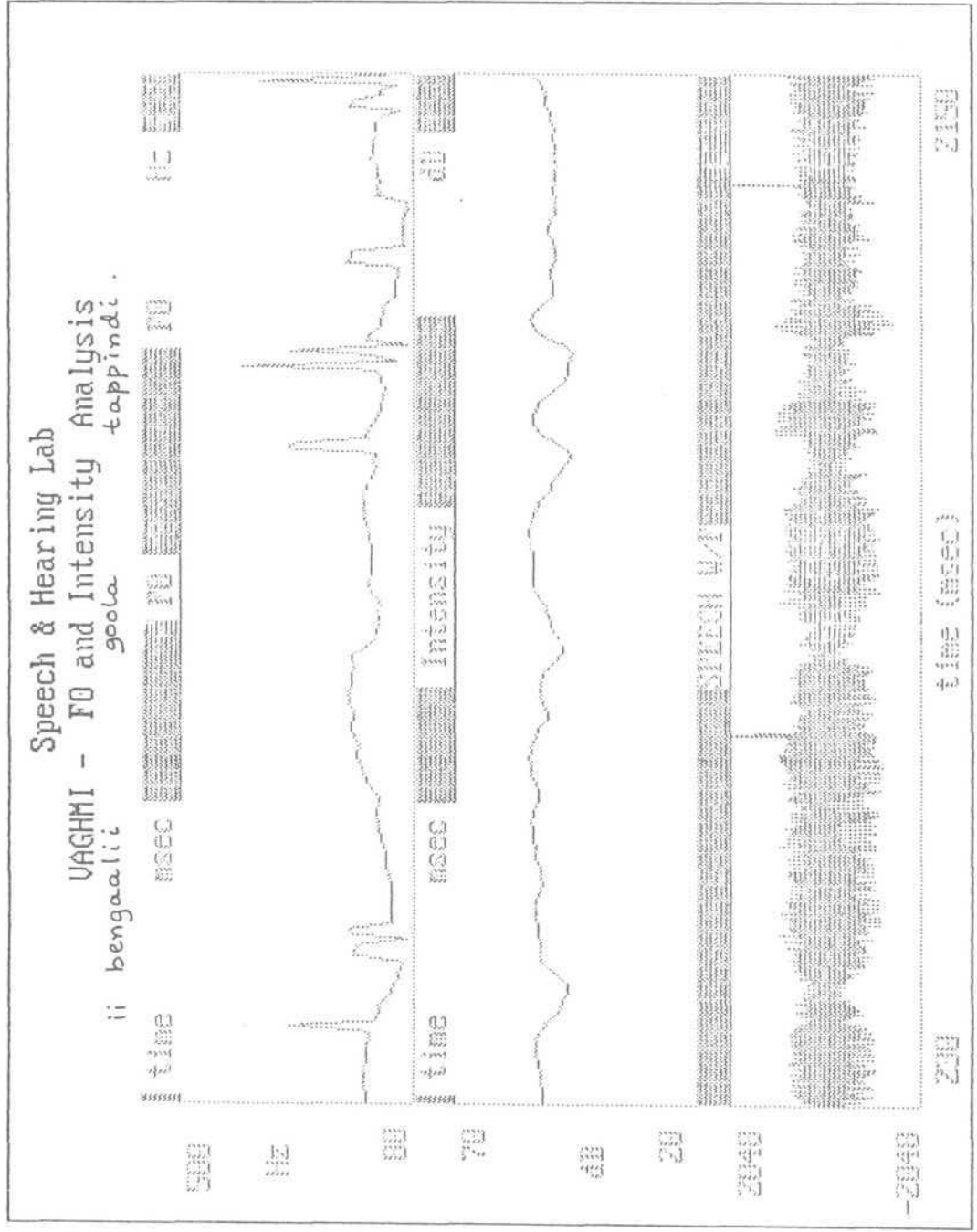
Sent. No.	M/F	Maximum Freq.	Minimum Freq.	Range	Average Range	Range in Males	Range in Females
1.	M	54	37	17	18	18	18
2.	M	51	32	19			
3.	F	51	33	18			
4.	F	50	32	18			

It can be seen from Table 2.6.1 that Telugu speakers while expressing frustration follow a Rise (steep) - fall (g) Rise (g) - fall (g) in 2nd and 4th sentences. But in 1st, 3rd sentences follow a Rise(g) - fall (s) - Rise (g) - flat fall - Rise(g) - fall (g) type of variation in Fo.

The terminal contour for "frustration was a gradual/steep rising pattern and gradual falling pattern for all four sentences in the initial and final contour of the sentence. The fundamental frequency variation and intensity variation were consistent with a difference of ± 20 and ± 2 for Fo-v and To-V respectively for all four sentences. The lo variations were consistent and showed a decrease in energy at end of sentences. Fo range and To range showed that the females used greater Fo range than males. The lo range of males and females were same.

In general it can be concluded that both male and female Telugu speakers have used Rise(s) - fall(g) - Rise(g) - fall(g) pattern in expressing the emotion frustration. The study of intensity changes in each sentence shows that the ' variations are consistent. Thus relation in terms of intensity variation could be found with the emotion expressed. The study of Fo range and lo range used in expressing the emotion frustration shows that females used greater Fo than males. Thejp range of males and females were same.

Graph 6. Intonation Contour : "Frustration". 101.a



ಈ ಬೋಲ ಗಾಲ ತಪ್ಪಿಂದ.

Thus it can be concluded that Telugu speakers use Rise(s) - fall (g) - Rise (g) - fall (g) type of intonation pattern in expressing "frustration". &S in Graph - 6 .

VII. WORRY:

Out of the four sentences expressing worry, two were spoken by males and other two by females. The Fo and lo variations of the four sentences analysed are presented in Table 2.7.1.

Table 2.7.1 Showing (Fo-v) and (lo-v) in sentences expressing "worry"

SI.				
No.	Speaker	Sentence		
1.	Male:	బాబు	వాళ్ళ నాన్న	కొనం
	Fo-v	173-140	134-127	108-133
	Io-V	43-49	49-40	41-33
		ఎంత బెంగ	పెట్టుకున్నాడో	ఏంటో ?
		149-164	176-155	152-158
		44-37	43-49	49-46

2.	Male:	మూడు	సంవత్సరాల	నంచి	ఎంత	చిత్రవధ
	Fo-v	117-126		97-110		113-119
	Io-V	54-58		44-42		47-52

	అనుభవించానా	తెల్ల !
	118-181	135-104
	50-51	53-51

3.	Female:	పాపం	నా కాసం	ఎక్కడెక్కడ	పెతుకుతున్నాడో !
	Fo-v	388-94	205-403	391-391	391-451
	Io-V	57-49	55-52	51-52	52-54

4.	Female:	ఇదంతో	నా వల్ల	జరిగింది .
	Fo-v	253-306	299-287	242-258
	Io-V	53-52	51-39	51-52

The fundamental frequency range and intensity range used by the speakers for expressing "worry" is presented in Table 2.7.2 and 2.7.3 respectively.

Table 2.7.2 showing frequency range in sentences expressing "worry".

Sent. No.	M/F	Maximum Freq.	Minimum Freq.	Range	Average Range	Range in Males	Range in Females
1.	M	192	78	114	271	210	332
2.	M	390	84	306			
3.	F	479	78	401			
4.	F	343	80	263			

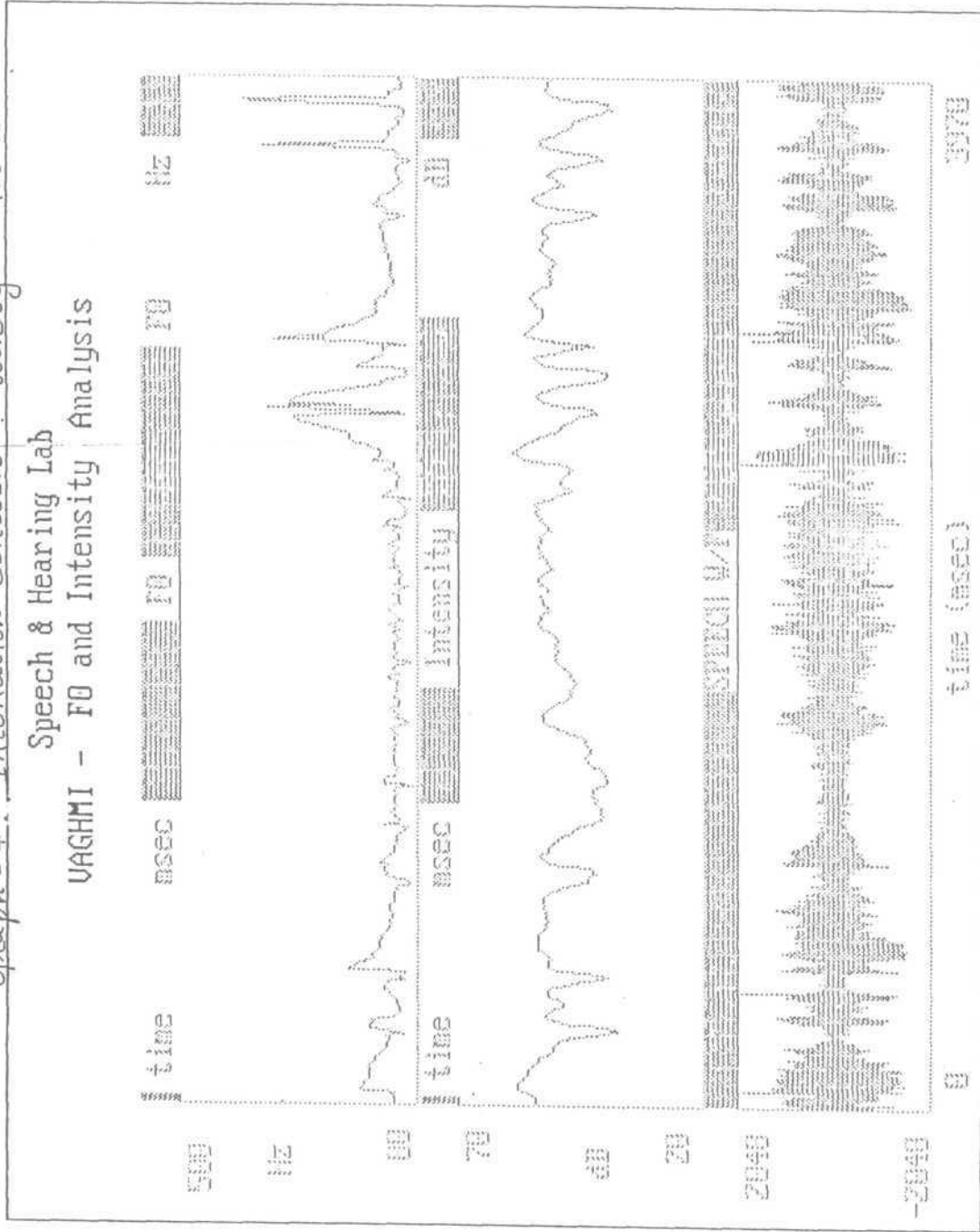
Table 2.7.3 Showing intensity range in sentences expressing "worry".

Sent. No.	M/F	Maximum Freq.	Minimum Freq.	Range	Average Range	Range in Males	Range in Females
1.	M	50	33	17	72	18.5	17.5
2.	M	59	39	20			
3.	F	57	38	19			
4.	F	55	39	16			

It can be observed from Table 2.7.1 that Telugu speakers while expressing worry follow a Rise-fall - Rise(g) - Fall(g) - Rise (s) - fall (s) and Rise-fall (g) - Rise (g) - fall (g) - Rise (s) - fall (g) in 2nd and 3rd sentences respectively. But in other two sentences 1st and 4th follow a Rise-fall (s) - flat - Rise(s) - flat (g) and Rise g (F) -flat - Rise (g) - fall (g) respectively. The terminal contour for "worry" was a Rise-Fall(g) and Rise (s) / Rise (g) - fall(g)/pattern for all four sentences. The fundamental frequency variations and intensity variations were consistent with a difference of ± 4 and ± 5 for Fo-variation and I₀-Variation respectively in all the four sentences. The I₀ variations were inconsistent and showed decrease in energy at end of sentences. On comparison of Fo range, it was found that females used greater Fo range than males. The I₀ range it was found to be used to a greater extent by males when compared to females.

In general it can be concluded that both male and female Telugu speakers have used Rise-fall(g)-Rise(g)-fall(g) pattern in expressing the emotion worry, the study of intensity changes in each sentence shows that the variations are not consistent. Thus no relation in terms of intensity variation could be found with the emotion expressed. The study of Fo range and I₀ range used in expressing the emotion shows that females used greater Fo than males. The I₀ range of males was greater Fo than males. The I₀ range of males was greater than females.

Graph - 7. Intonation Contour : "Woxy" 105.a



పాపం నా కాసం ఎక్కడక్కడ పెరుకుతున్నాడో.

Thus it can be concluded that Telugu speakers use Rise-fall(g) - Rise (g) - g(Fall) - Rise(s) - fall(g). Type of intonation pattern in expressing "worry" as in

VIII SURPRISE:

Out of the four sentences expressing surprise, two were spoken by males and other two by females. The Fo and Jo variations of the four analysed sentences are noted in Table 2.8.1

Table 2.8.1 Showing (Fo-v) and CLo-V) in sentences expressing "Surprise".

Sl. No.	Speaker	Sentence			
1.	Male:	అబ్బ!	నా కెండుకమ్మ	అంత అదృష్టం.	
	Fo-v	108-158	130-150	287-410	
	lo-V	47-51	55-53	51-37	
2.	Male:	అరె!	కాకిగడ	పెడితె అకడికి ఎలా వెళ్ళంది?	
	Fo-v	153-206	87-161	177-176	176-161
	lo-V	57-41	48-48	52-51	53-50

3.	Female:	అమ్మో !	ఈ కాలంలా	ఎవరెలాంటి
	Fo-v	249-339	84-232	210-205
	I _o -V	55-51	52-52	51-52
		వాళ్ళూ	నమ్మలేక	పాతున్నాము !
		225-250	226-132	210-189
		54-52	53-44	52-52

4.	Female:	ఓ అదాండి !	భవనాగరంఅంటే	కష్టాలన్నమాట.
	Fo-v	238-307	241-400	290-484
	I _o -V	44-38	41-41	34-46

The Fo and I_o ranges used by subjects in expressing "Surprise" are presented in Table 2.8.2. and Table 2.8.3 respectively.

Table 2.8.2. Showing Fo range in sentences expressing "Surprise".

Sent. No.	M/F	Maximum Freq.	Minimum Freq.	Range	Average Range	Range in Males	Range in Females
1.	M	410	78	332	316.5	303.5	329.5
2.	M	361	86	275			
3.	F	381	80	301			
4.	F	516	158	358			

Table 2.8.3. Showing lo range in sentences expressing "Surprise"

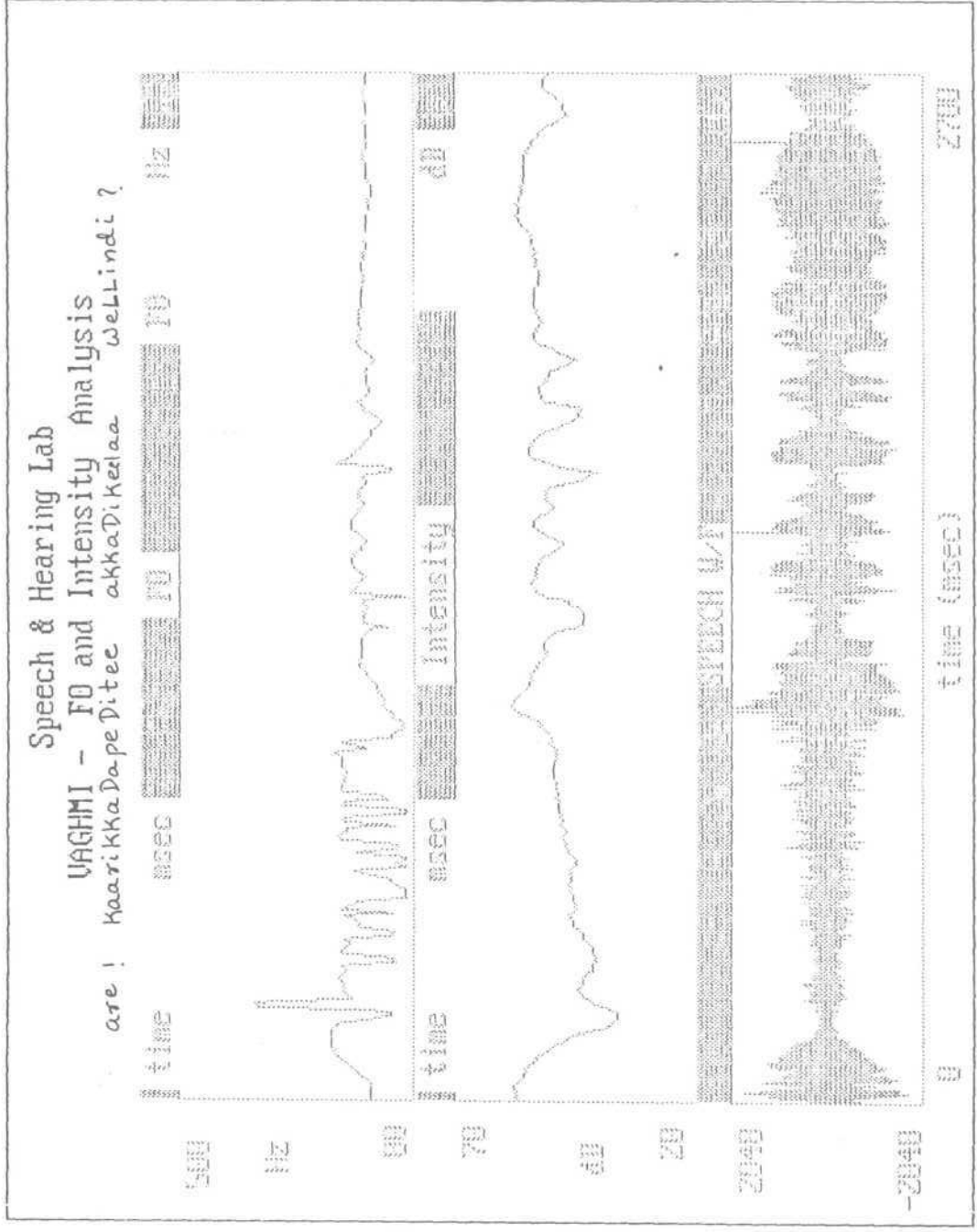
Sent. No.	M/F	Maximum Freq.	Minimum Freq.	Range	Average Range	Range in Males	Range in Females
1.	M	54	37	17	22.25	19.5	25
2.	M	58	36	22			
3.	F	57	37	20			
4.	F	54	24	30			

It can be concluded from the study of Table 2.8.1 that Telugu speakers while expressing "surprise" followed a rise (g) - fall(g) - flat Rise(s) - flat - fall(g) in first 2 sentences and Rise(g) - flat (g) - Rise(s) - flat - Rise (s) and Rise(g) - flat(s) - Rise(g) - flat - fall(s) - Rise (g) - flat (g) in 3rd and 4th sentences respectively.

The terminal contour for "Surprise" was a Rise(g) - fall (g) - flat in the mild portion and Rise (g) and fall (g) pattern for all four sentences in the initial and final contour of the sentence. The fundamental frequency variations and intensity variations were not consistent for all four sentences. The 3b variation were inconsistent and showed decrease in energy at end of sentences. Study of Fo ranges and Jo ranges were found that females used greater Fo range than males.

In general it can be concluded that both male and female Telugu speakers have used Rise(g) - fall(g) - flat - Rise(g) - flat - fall(g) pattern in expressing the emotion surprise. The study of intensity changes in each sentence shows that the variations are inconsistent. Thus no relation in terms of intensity variations could be found with the emotion expressed. The study of Fo range and Jp range used in expressing the emotion surprise shows that females used greater Fo range than males, and I₀ range was found to be greater for females than males.

Graph 8. Intonation Contour : " Surprise". 109.a



ಅರೆ ! ಕಾರಿಕ್ಕಡ ಪಡಿಪೆ ಅಕ್ಕಡಿ ಸಿಲಾ ಪೆಲ್ಲಿಂದಿ ?

Thus it can be concluded that Telugu speakers use Rise (g) - fall(g) - flat - Rise (g) - flat - g() type of intonation pattern in expressing "surprise" dS in graph -8.

IX. JEALOUSY

Out of the four sentences expressing jealousy two were spoken by males and other two by females. The Fo and Jo variations of the four analysed sentences are given in Table 2.9.1.

Table 2.9.1 Showing (Fo-v) and (Io-V) in sentences expressing "jealousy"

Sl. No.	Speaker	Sentence			
1.	Male:	ముఖ్యంగా	మలాంటి	భాండసులు	నాలాంటి
	Fo-v	48-112	113-214	168-113	179-228
	Io-v	34-32	36-36	35-35	47-50
		మధువులు చొస్తున్న	త్రయోగాలు	తప్పకుండా	ఎని వేరాల
		217-186	167-168	103-126	126-123
		51-50	48-32	43-41	41-43

2. Male:	కౌతి, గిరి	అనరాస్త	అదీ
Fo-v	139-164	163-219	231-134
Io-v	51-55	55-50	52-42

కవిత్వం కాదు	కవిత్వం !
287-126	163-158
42-48	52-39

3. Female:	నీ కౌమి రాదుసా!	న దగ్గర	నానామి	సార్బుకాను .
Fo-v	316-282	294-345	349-310	307-294
Io-v	43-33	41-44	45-50	50-32

4. Female:	నిన్ను	నమ్మింబట్టిన	అవసరం	నాకం	తాడు .
Fo-v	280-270	267-242	234-288	273-120	
Io-v	47-54	55-55	55-53	53-40	

Table 2.9.2. Showing frequency range in sentences expressing "Jealousy"

Sent. No.	M/F	Maximum Freq.	Minimum Freq.	Range	Average Range	Range in Males	Range in Females
1.	M	525	90	435	352.25	428.5	276
2.	M	500	78	422			
3.	F	367	98	269			
4.	F	363	80	283			

Table 2.9.3. Showing Intensity range in sentences expressing "jealousy".

Sent. No.	M/F	Maximum Freq.	Minimum Freq.	Range	Average Range	Range in Males	Range in Females
1.	M	53	22	31	28.5	34.5	22.5
2.	M	56	18	38			
3.	F	54	25	25			
4.	F	56	40	16			

It can be concluded from Table 2.9.1 that Telugu speakers while expressing "jealousy" followed Rise-fall(g) - flat in the initial part and terminal contour of the sentences had Rise(s) - fall(g) pattern of intonation in all the four sentences. The 2nd and 3rd statements showed an intonation pattern of Rise-

fall(g) - flat - Rise - fall(g). The sentence expressing jealousy in the (g) form of statements i.e. 1st and 4th showed an intonation pattern of

1st Rise (s) - fall(s) - Rise(g) - fall(g) - Rise (s) - fall(s) - Rise(s) - Fall(g)

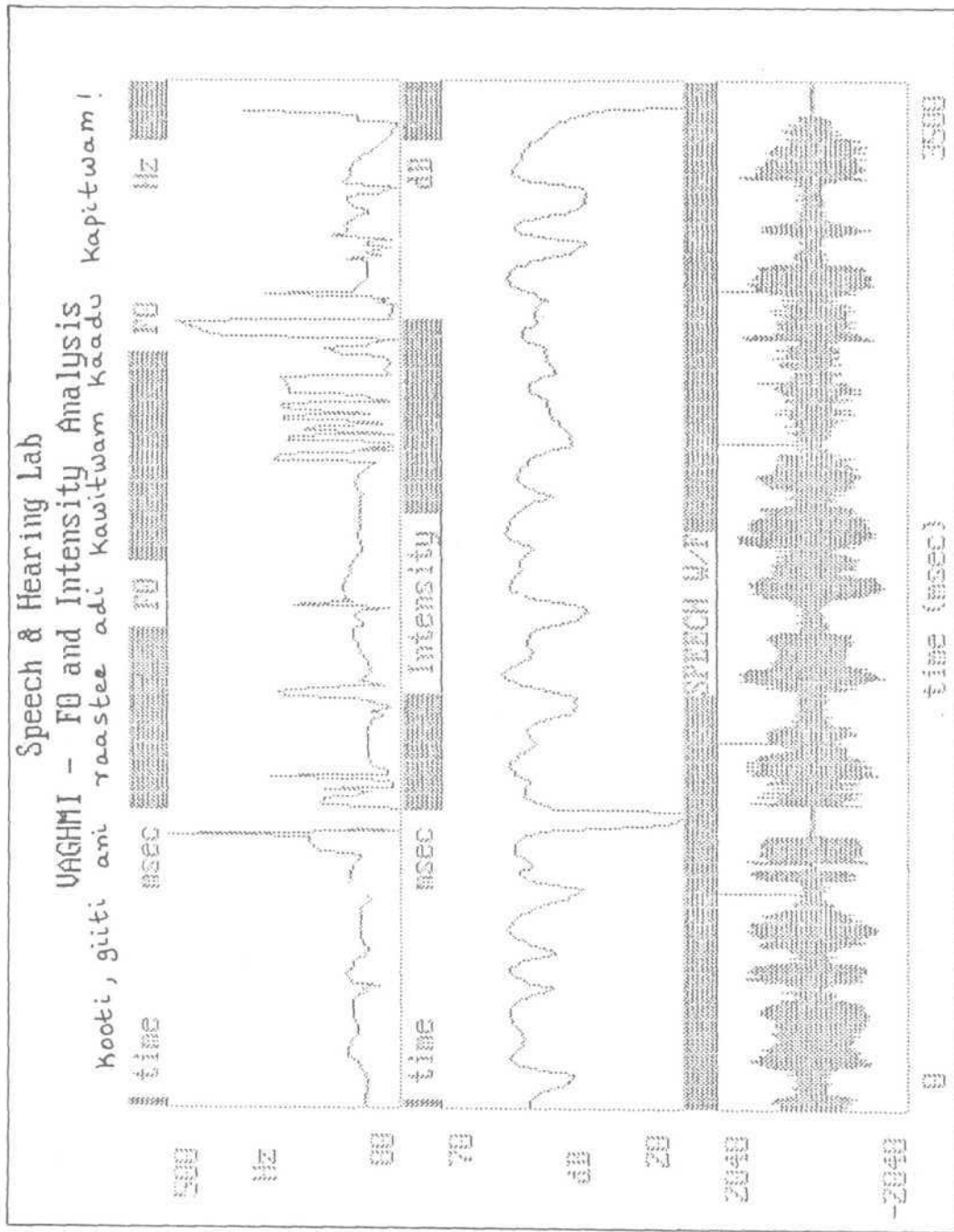
4th Rise - fall(g) - Rise(s) - fall(g) - Rise (g) - fall(g)

The initial part of the contour of the statements (2) and (3) depicted a rise - fall - flat and Rise - fall(g) in the final part of the sentence whereas the 1st and 4th statements showed Rise(s) - fall(g) in both initial and ending part of the sentence. Thus terminal contour helps in determining sentence type. The To variations were inconsistent showed a decrease in energy at end of sentences.

Comparison of Fo range and Jo range between males and females was found that the males used greater Fo range and Jo range than females.

In general it can be concluded that both male and female Telugu speakers have used Rise - fall(g) - flat - fix(g) - fall(g) pattern in expressing the emotion surprise. The study of intensity changes in each sentence shows that the variations are inconsistent. Thus no relation in terms of intensity variations could be found with the emotion expressed. The study of Fo range and To range used in expressing the emotion jealousy shows that males used greater Fo range and Jo range than females.

Graph. 9. Intonation Contour : "Jealousy" - 113.a



కాత్ర, గతి అని రాస్తే అది కవిత్యం కాదు కవిత్యం!

Graph - 9 shows the intonation pattern of Rise -fall(g) - flat - Rise - fall(g) type of intonation pattern in expressing "jealousy".

After studying the various fundamental and intensity variations for each emotion, the intonation pattern of each emotion that was used by Telugu speakers could be well determined. Both male and female subjects had fundamental frequency within the normal range.

^ It can be concluded that different types of intonation patterns were used by Telugu speakers under various emotional conditions as shown in Table-3

Showing the intonation patterns under various emotional conditions.

Emotion	Terminal Contour	Intonation Pattern
1.Fear	fall(g)	Rise-flat-fall-Rise-fall(g)
2. Anger	fall(g)	Rise(s)-fall(g)-Rise(g)-fall(g)-Rise(g)- fall(g)
3. Joy	fall(steep)	Rise(g)-fall(g)-Rise(s)-flat-fall(s)
4. Neutral	fall(g)	Rise-fall-Rise-fall(g)
5. Grief	Flat(g)	Rise(s)-fall(s)-flat-Rise(s)-fall(s)

6. Frustration	fall(g)	Rise(s)-fall(g)-Rise(g)-fall(g)
7. Worry	fall(g)	Rise-fall(g)-Rise(g)-fall(g)-Rise(g)-fall(g)
8. Surprise	fallg)	Rise(g)-fall(g)-flatORise(g)-flat-fall(g)
9. Jealousy	fall(g)	Rise-fall(g)-flat-Rise-fall(g)

Nandini (1985) did a similar study to find out the intonation pattern used by Kannada speakers and the results indicated that in Kannada different intonation patterns are used expressing different emotions.

Chandrashekar (1985), did a study on intonation patterns used by Hindi speakers for different emotions and he found that Hindi speakers use different intonation patterns to express different emotions. Thus, according to the objective analysis, of the present study, the hypothesis stating that in Telugu different intonation patterns are used in expressing different types of emotions has been accepted as seen from Table-3

The present study shows a minor difference in intonation pattern used by males only in the emotion joy due to the same pattern in form of praising statements. There is evidence of different intonation patterns being used by males in joy emotions as seen from the present study using Telugu speakers.

No difference in intonation patterns among males and females have been reported by Chandrashekar, (1985) and Nithun (1998) in Hindi language, Nataraja (1982), Manjula (1979) and Nandini (1985) in Kannada language. In 1999, Srabanti Saha reported that in Bengali language, intonation patterns used in different emotions was the same in both males and females. Therefore it can be concluded that in Telugu language, intonation patterns used in different emotions was the same in both females and males.

Though it can be concluded that intonation patterns observed differ with emotions, however, not much difference is found in the intonation patterns between worry and grief:. It may be that the same kind of intonation pattern may be used to express similar types of emotions. Except for the sentences expressing emotion 'worry' and 'grief' all other types of sentences have shown intonational pattern specific for each type. These results are partly in agreement with the findings of Manjula (1979) and Rathna et al (1982). that different intonation pattern can be used to express different emotion.

In the present study it has been found that the intensity variations in the four sentences of a particular emotions are inconsistent, except being consistent only for emotion frustration ie., they did not follow the same pattern. It can be stated that the perception of the intonation contour depends on the fundamental frequency variations that take place during the utterance, than on intensity

variations. Small variations in frequency may not be identified by subjective analysis but are well detected by objective analysis. The results of the present study support the view of Pike (1945) and Lado (1961) that the variations in fundamental frequency of voice is the basis for perception of intonation contours. Further, the results of this study do not agree with the results of Denes (1959) which states that it is not always the variations in fundamental frequency that contributes for intonation contour. Studies done by Nandini (1985) in Kannada and Chandrashekar (1985) on intonation patterns in Hindi also support the results of the present study that variations in fundamental frequency is the basis for perception of intonation contours.

Thus, it can be concluded, that the hypothesis stating that intensity variations do not indicate specific pattern in different emotions has been accepted.

In the present study most of the Fo variation contours show a falling pattern at the end of the sentences except for few emotions. 'Joy ' and 'Grief ' showed a rising pattern in the final contour where as anger, Fear, Surprise, Jealousy, Worry, Frustration, Neutral showed a falling pattern at the end of the sentences.

It has been found that there was lowering of fundamental frequency or falling type of intonation at the end of the sentences in expressing five emotions studied by Nataraja (1982). A falling pattern of terminal contour has also been suggested by Chandrashekar (1985) in Intonation contour of Hindi language and also in Kannada language by Nandini (1982). Liberman (1980), Sorenson and Cooper (1977) have stated that American English sentences are often characterized by fall in intonation curve. Falling pattern was observed in declarative sentences and in questions which were impossible to answer with yes-no. From the present study it is found that 'yes-no' questions irrespective of the emotion expressed showed a falling pattern and for few rising pattern types in the terminal contour. This view has been supported by the study done by Liberman (1980) who stated that pitch rise indicated a question to be answered with 'Yes or No' and also sentences which are incomplete. Thus, it may be possible that the final or terminal contour may be same for different emotional conditions, but the differences may be found in other parts of the contour, as it is seen in the present study. From the study of the fundamental frequency range and intensity range in males and females it was found that among Telugu speakers females used a greater frequency range in emotions Fear Anger, Joy, Grief, Frustration, Worry and Surprise where as males used greater range for neutral, jealousy. Frequency range in expressing frustration was the largest and smallest in expressing in Joy and Surprise. Jealousy, Neutral had a reduced

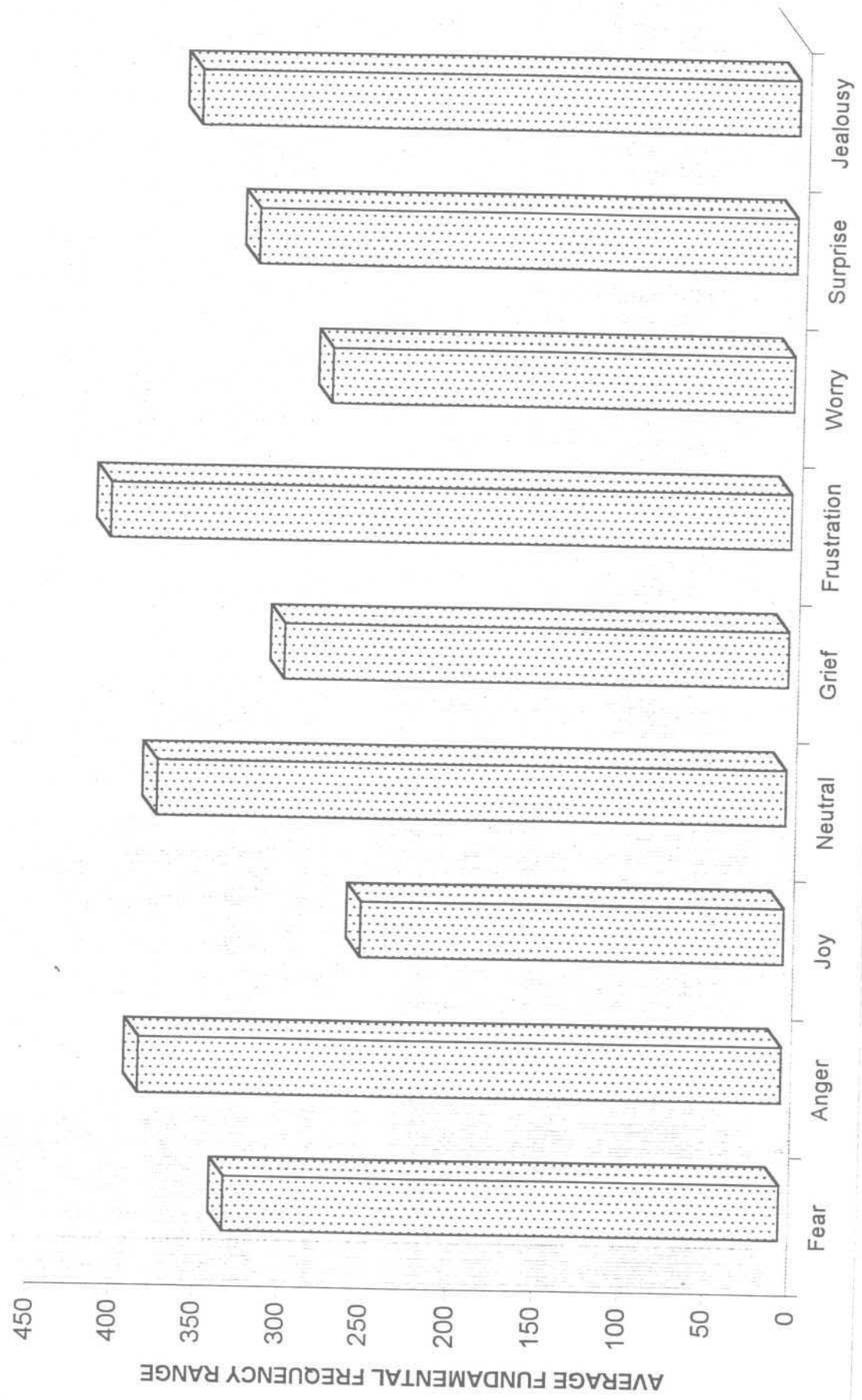
range when compared to anger and the range used was nearly the same for expressing the frustration.

Intensity range was largest in sentences expressing jealousy and narrowest for sentences expressing Fear. Females used a greater, intensity range when compared to males in most of the emotions.

Nithun (1998) did a study on intonation used by Hindi speakers and his results partly support the results of the present study stating that the females used a greater Fo range and intensity range than males in expression of all the emotions.

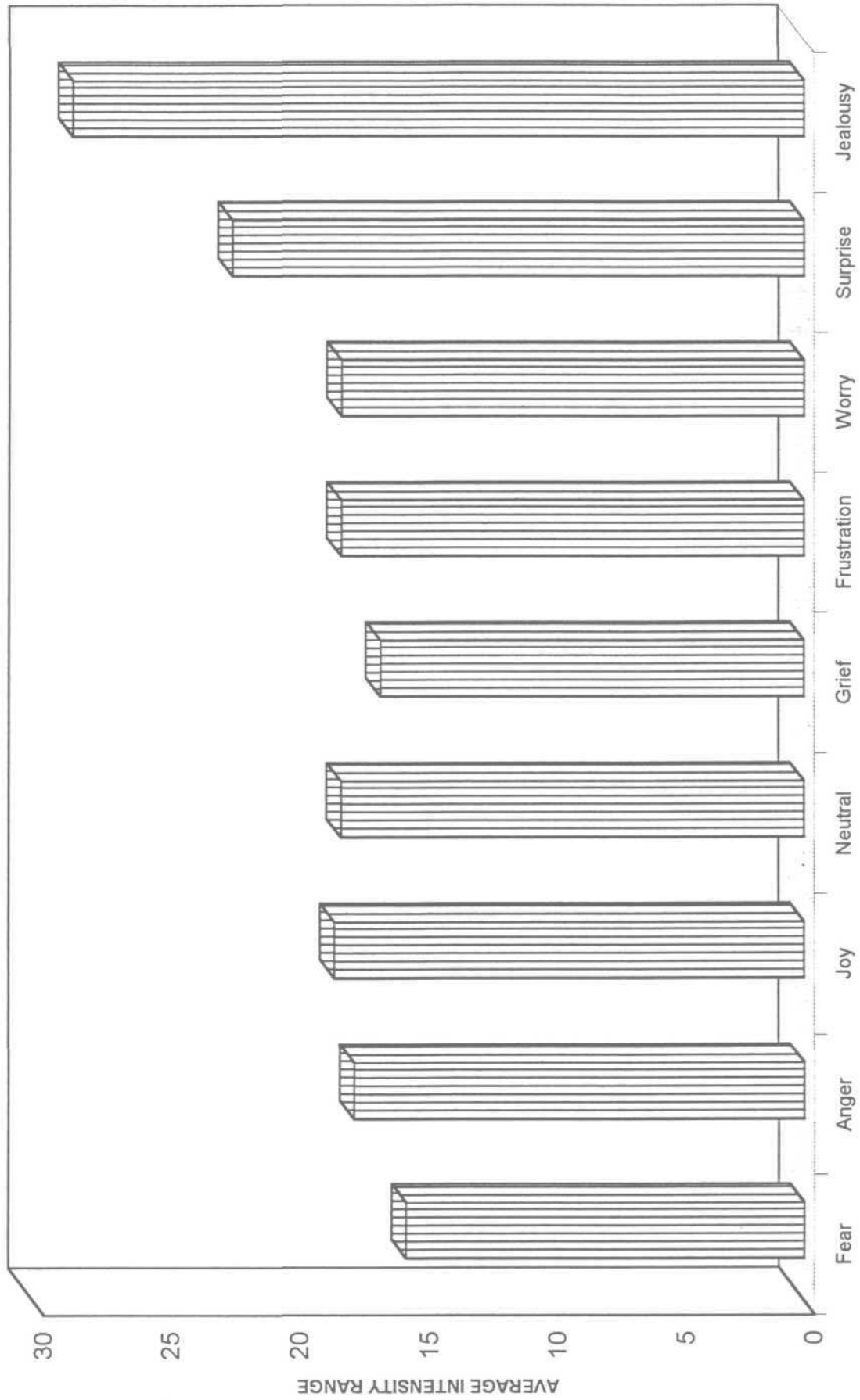
Graphs showing Fo range, Ip range as shown by males and females.
Table 4. Showing the Fo range and intensity range in various emotions and also comparison of range between males and females.

SHOWING FUNDAMENTAL RANGE IN DIFFERENT EMOTIONS

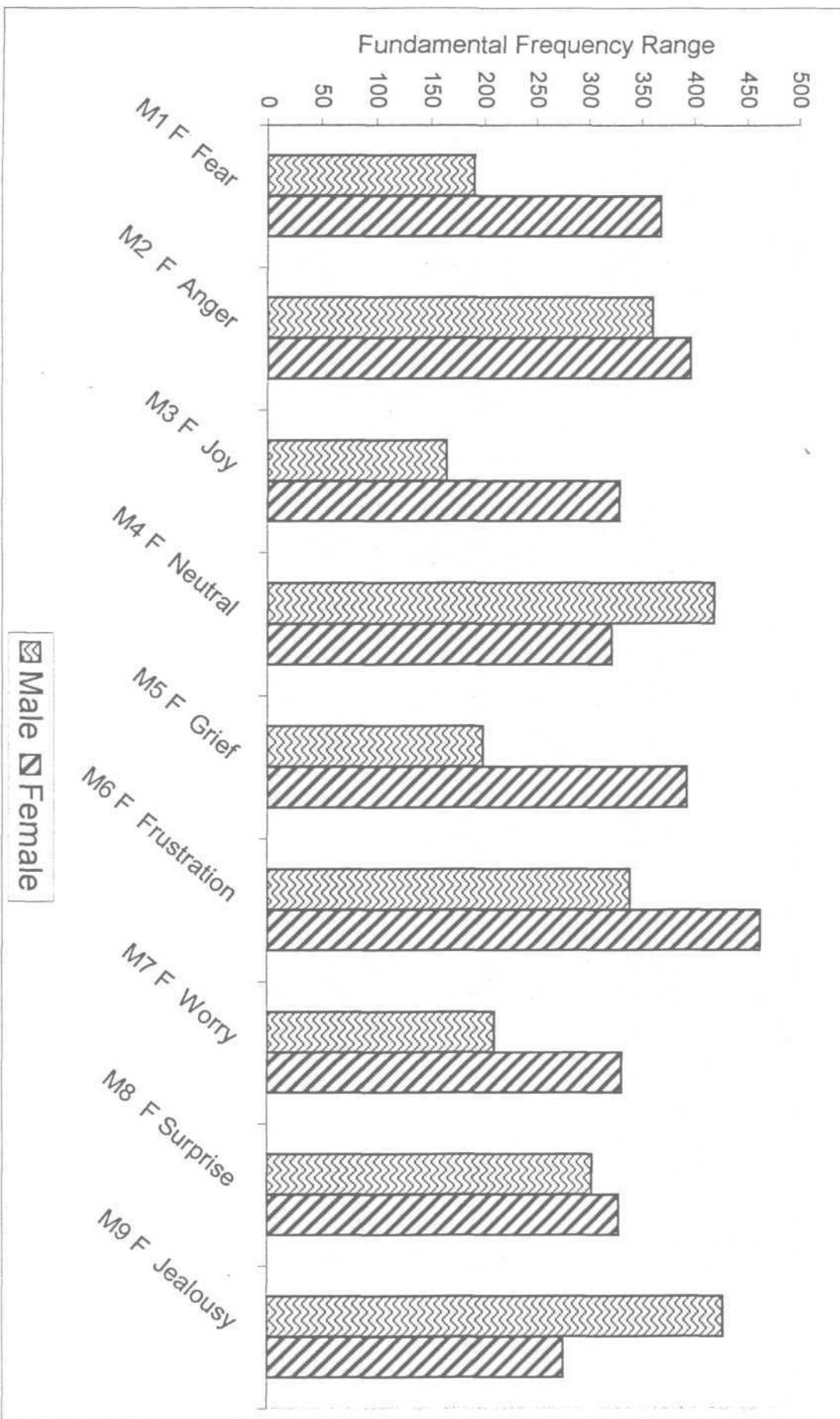


119.6

SHOWING INTENSITY RANGE IN DIFFERENT EMOTIONS



SHOWING COMPARISON OF FUNDAMENTAL FREQUENCY RANGE BETWEEN MALES AND FEMALES



Itt-dL

SHOWING COMPARISON OF INTENSITY RANGE BETWEEN MALES AND FEMALES

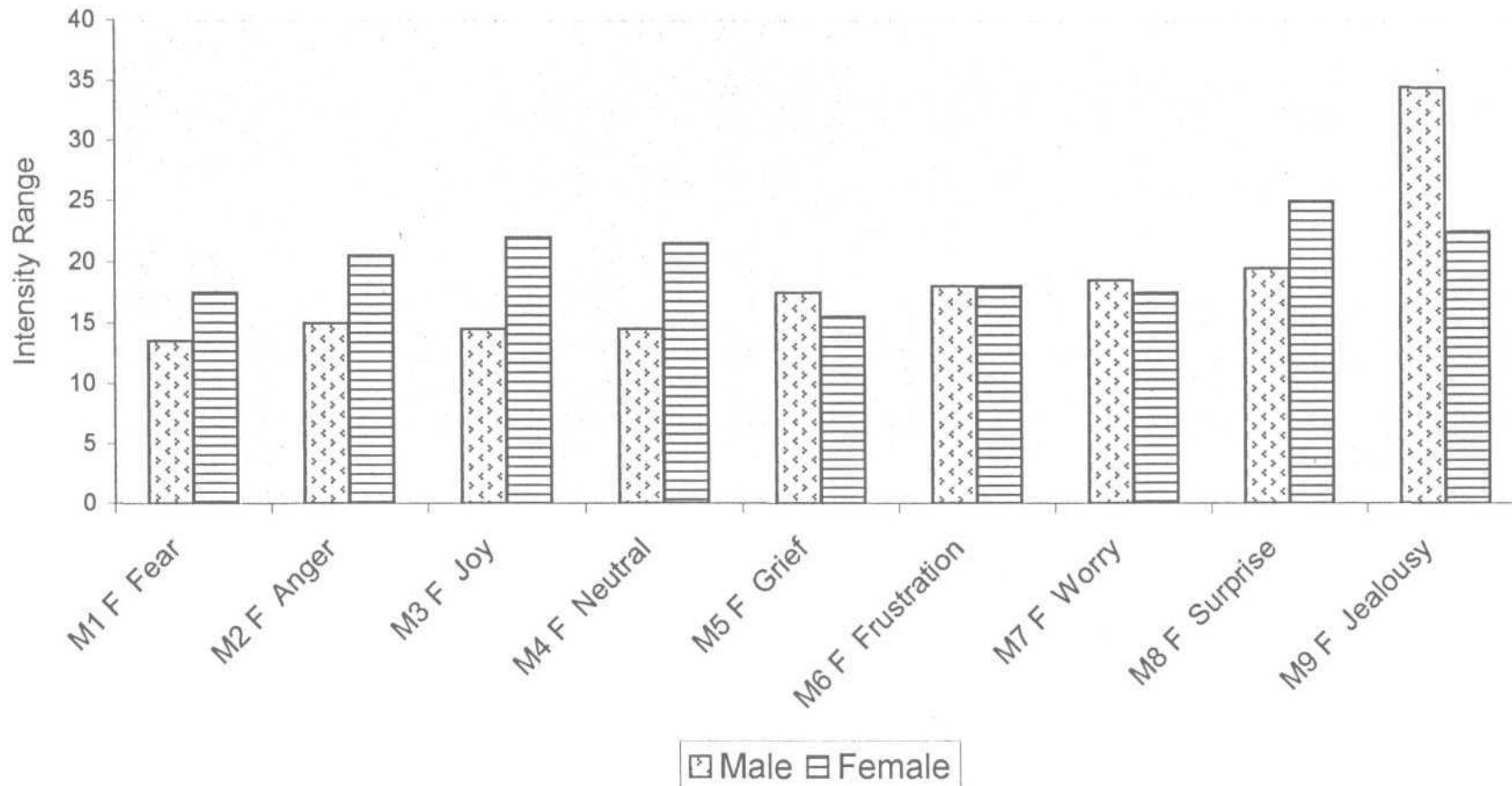


Table - 4: Showing the Fo range and intensity range in various emotions and also comparison of ranges between males and females

Emotion	Frequency Range	Comparison in Males/Females	Intensity Range	Comparison in Males and Females
Fear	326.5	F > M	15.5	F > M
Anger	378.75	F > M	17.5	F > M
Joy	247.25	F > M	18.25	F > M
Neutral	370.75	M > F	18	F > M
Grief	296.25	F > M	16.5	M > F
Frustration	401.5	F > M	18	M = F
Worry	271	F > M	18	M > F
Surprise	316.5	F > M	22.25	F > M
Jealousy	352.25	M > F	28.5	M > F

Perceptual analysis was done to find out whether the non-native Telugu speakers as listeners could perceive the intonation similar to that of native Telugu speakers. Bolingers (1972) has stated that it is the perceptual analysis that is important in understanding the intonation, as it is the ultimate determiner of meaning. The results of the present study ie; the perceptual scores (Appendix - B) differentiating different emotions by non-native and native speakers are presented in Table 5.

120.02

SHOWING COMPARISON OF PERCEPTUAL SCORES BETWEEN NATIVE AND NON-NATIVE SPEAKERS

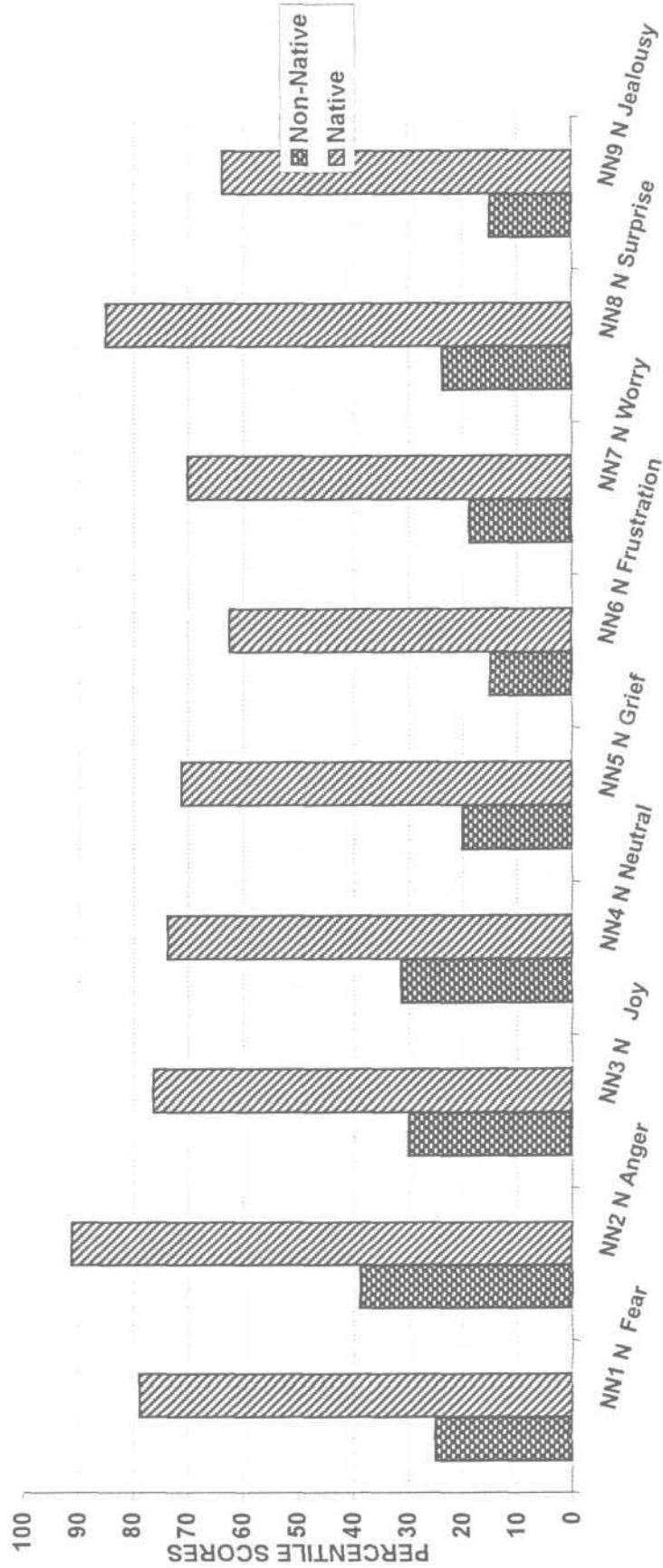


Table 5, Showing the perceptual scores in % for different emotion in native and nonnative speakers.

Table - 5: Showing the perceptual scores in % for different emotion in native and non-native speakers.

Sl. No.	Emotion	Native Speakers	Non-native Speakers
1.	Fear	78.75%	25%
2.	Anger	91.25%	38.75%
3.	Joy	76.25%	30%
4	Neutral	73.75%	31.25%
5.	Grief	71.25%	20%
6.	Frustration	62.5%	15%
7..	Worry	70%	18.75%
8.	Surprise	85%	23.75%
9.	Jealousy	63.75%	15%

The study of Table-5 shows that the native speakers had identified the different sentences expressing emotions ranging from 91.25% to 62.15%.

The non-native speakers had identified the emotion Anger 38.75% ie., the 'anger' has been expressed well in terms of intonation in other words, the non-native speakers/listeners had difficulty in identifying the emotions solely based on intonation. The expression of frustration and jealousy seems to be not very clear,

as both native as well as non-native speakers had shown lowest scores of identification that is 62.15% and 15% respectively. The sentences expressing jealousy also had lead to poor identification scores of 63.75% and 15% in case of native, non-native speakers respectively. The remaining sentences also showed scores between these scores. Thus, it can be concluded that the sentences selected were actually representing the emotions ie, they were selected for both, as identified by both native and non-native speakers. Emotions anger, joy, grief, jealousy, worry and neutral had been expressed well using intonation patterns as they could be well identified by both native and non-native speakers. Emotions like frustration, jealousy, fear were not well expressed using intonation patterns.

However, in perceiving anger the non-native speakers also showed a high score this may be due to the use of high Fo range and intensity range in anger. Frustration and jealousy were poorly identified by the non-native Telugu speakers and compared to other emotions. It was found that even native speakers perceived sentences expressing frustration, mostly as 'grief inspite of the presence of contextual clues. This may be because similar intonation patterns were used by Telugu speakers while expressing 'grief and 'frustration'. But in general native speakers could identified the intonation patterns of different emotions better than the non-native speakers (Appendix - B)

It can be concluded that the hypothesis stating that native speakers can identify the intonation pattern better than non-native speakers is accepted as the identification scores of various emotions by the native speakers is more than the non-native speakers (Table -5). Better identification of the emotion by native speakers as seen in Table-5 can be contributed to contextual clues and comprehension of meaning of the words and linguistic content in a sentence.

Thus, it may be concluded, based on the results of the present study that Telugu speakers used different intonation patterns to express different emotions and the intonation contours depend upon the fundamental frequency variations rather than on intensity variations. Further, it may also be concluded that native Telugu speakers can identify the intonation patterns much better than the non-native speakers.

Thus, the results of the present study indicate:

1. In Telugu different intonation patterns are used in expressing various types of emotions
2. The intensity variations do not show difference in pattern under different emotions.
- * 3. The perception of intonation mainly depends upon the Fo-variation

4. Terminal contours are useful in determining the form of the sentence ie; statements and Yes-No questions
5. The intonation patterns used by Males and Females do not differ
6. The frequency and the intensity ranges used by female or greater than by males
7. The native Telugu speakers were able to identify the intonation much better than the non-native Telugu speakers.

The results of the present study can be used for several purposes like speech synthesis, teaching the deaf, therapy for aphasia etc. Further studies using larger samples and population are recommended.

SUMMARY AND CONCLUSIONS

Speech is an established communicative system of arbitrary and conventionalized acoustic symbols, produced mainly by the action of muscles of the respiratory and upper respiratory tracts (Travis, 1957). Prosody has been viewed as decorative ornamentation, functioning to make speech more aesthetically pleasing. Prosody functions as the foundation or structured support for the organization of speech communication. (Freeman, 1983).

"Intonation like everything else in language is one instrument in an orchestra" (Bolinger, 1972). When one analyses good speech, the speech that most adequately contributes to social interaction, is discovered that it possesses certain characteristics. Each of these characteristics make their particular contribution to the total impression. Some of the important characteristics of speech are loudness, pitch intonation, inflection, rhythm, voice quality, articulation, stress, accent style, level of language and the kind of language. (Bolinger, 1972). Intonation is an exclusive term referring to pitch as a function of time and may be applied to a simple inflexion or to long term variation in phrases over a numerous inflectional shifts. (Greene, 1964).

Intonation has been considered to be functioning at different levels of language, i.e., syntactic, lexical, phonological and also in providing information regarding condition of the speakers, emotion and others.

Abnormal prosody is a characteristic of deaf children and is also affected in language disordered children and adults. Thereby for deaf and aphasics include teaching intonation as it has been found to facilitate acquisition of language.

Study of intonation in a given language permits better understanding of the language and also helps in intervention programmes. Thus there is need for knowing the intonation used in language for the purpose of teaching language.

The present study aimed at finding out the intonation patterns used by native Telugu speakers under different emotional conditions. 36 sentences were selected randomly from two Telugu movies audio cassettes as:

1. The emotions expressed, are produced as natural as possible.
2. The emotions are conveyed by speakers to the listeners only through speech. I.e., without any visual cues.

Twenty native Telugu speakers and Twenty non native speakers of age range 18-30 yrs served as subject for perceptual study.

Nine emotions, i.e., fear, anger, joy, neutral, grief, frustration, worry, surprise, jealousy were considered as the basic emotions for the study. Four sentences were chosen randomly to express each emotion. Both male and female subjects were considered.

In the present study both objective and perceptual analysis were done. The objective analysis was done using the Vaghmi "Fo-Int" programme. In perceptual analysis both the groups, i.e., native Telugu speakers and non native speakers were made to listen to the 36 sentences, that were randomly chosen from the two audio movie cassettes, and asked to identify the emotions expressed in the sentences.

The results obtained by objective and perceptual analysis follows:

- a. In Telugu different intonation patterns are used in expressing various types of emotions.
- b. The intensity variations do not show difference in pattern under different emotions.

- c. The perception of intonation mainly depends upon the F_0 variation.
- d. Terminal contours are important in determining the form of the sentence, i.e., statements and Yes-No questions.
- e. The intonational patterns used by males and females do not differ.
- f. The frequency and the intensity range used by the females were greater in more number of emotions when compared to males.
- g. The native Telugu speakers were able to identify the intonation much better when compared to non native Telugu speakers.

RECOMMENDATIONS:

1. A more detailed study with more speech samples may be taken up.
2. Natural speech can be used to study the intonation pattern in Telugu.
3. Using the procedure developed by this study the intonation in other languages may be studied.
4. Other prosodic aspects in Telugu can be studied using the same methodology.

BIBLIOGRAPHY

1. Abe, I, (1955). Cited in Fry, D.B (1968). "An Japanese Intonation". Nor-Holland Publishing Company, Amsterdam, 156-183.
2. Allen, P. (1973). "Speech rhythm - its relation to performance universals and articulation timing", *Journal of Phonetics*, 3, 219-237.
3. Anisworth, (Ed), W.A. (1976). "Perception of Prosodic features". (Ed), Terhaar Pergamon Press, London.
4. Balasubramanian, T. (1980). "Timing in Tamil", *Journal of Phonetics*, 8, 449-467.
5. Barry, A. (1981). Cited in Cruttenden, A. (1986). "Intonation". Cambridge University Press, New york, 78-80.
6. Blumsten, S., Cooper, E.W. (1974). "Hemispheric processing of Intonation Contour", *Cortex*, 10, 446-450.
7. Blumsten, S., Cesper, P. (1974), Cited in Cruttenden, A. (1986), "Intonation". Cambridge University Press, New york, 150-152.
8. Bolinger, D.L. (1972), "Intonation: selected readings". Penguin Books Ltd., England.
9. Brackett, R.L. (1971): The respirometer as a diagnostic and clinical tool in the speech clime. *Journal of Speech and Hearing Disorders*, 36, 235-240.
10. Brackect, J.P. (1971). Para meters of voice quality handbook of speech pathology and audiology (Ed by Travis). Appleton - century - crofts, New york, 441.
11. Buhler, S., Hetzer, L. (1928). Cited in Prasad, C. (1985). "Some Prosodic Aspect in Hindi". Unpublished Dissertation, University of Mysore.
12. Condon, W.S., Sanders, L.W, (1974). "Synchrony demonstration between movements of the neonate and adult speeh. In Lass, N.J. (1980). *Speech language and hearing*, 456-162.

13. Cooper, W.E, Sorenson, J.M. (1977). "Fundamental frequency contours at syntactic boundaries". *Journal of the acoustic society of America*, 62, 683-692.
14. Corlew, M. (1968). "A developmental study of intonation recognition". *Journal of speech and hearing research*, 11, 825-833.
15. Cruttenden, A. (1986). "Intonation". Cambridge University Press, New York.
16. Darley, F. (1979). Cited in Prasad, C. (1985). "Some Prosodic Aspect in Hindi". Unpublished Dissertation, University of Mysore.
17. Darwin, (1975) cited in Nandini. (1985). "Some Prosodic Aspect in Kannada". Unpublished Dissertation, University of Mysore.
18. Darley, F., Aronson, A., and Brown, J. (1979). "Clusters of deviant speech dimensions in Dysarthrias". *Journal of speech and hearing research*, 12, 462-496.
19. Delattre, P. (1962). "Some factors of vowel duration and their cross linguistic validity". *JASA*, 34, 1141-1143.
20. Denes, P. (1959). "A preliminary investigation of certain aspects of language". *Journal of Speech and Hearing Research*, 2, 106-110.
21. Eisenon, J., Irwin, J.V. (1963). Cited in Nandini (1985). "Some prosodic aspects in Kannada". Unpublished dissertation, University of Mysore.
22. Fant, G. (1975). "Auditory analysis and perception of speech". Academic Press, London.
23. Freeman, F.J. (1978). Cited in Lass, N.J. (1982). "Speech language and hearing". 2,388-392.
24. Freeman, F.J. Prosody in perception production and pathologies, Chap 26, In *Speech Language and Hearing*, Vol. n, Lass, N.J., (Ed), W.B. Saunders company, (1982).
25. Freeman, F.J. (1983). Cited in Cruttenden, A. (1986) "Intonation". Cambridge University Press, New York, 48-50.

26. Fry, D.B. (1968). "Manual of phonetics". North Holland Publishing Company, Amsterdam.
27. Fry, D. B. (1978). "Acoustic phonetics". Cambridge University Press, New York..
28. Gray, N., Wise C.E. (1959). Cited in Cruttenden, A. (1986). "Intonation". Cambridge University Press, New York, 93-96.
29. Greene M.C.L. (1964). "The voice and its disorders". Pittam Medical Publishing, Co. Ltd., London.
30. Haggard, M.P. (1975): Cited in prosody in perception, production and pathologies - by Freeman, J.F. in Speech Language and Hearing, Vol. 2, Pathologies of Speech and Languages, Vol. 2 pathologies of Speech and Languages. Ed. Lass, N.J. Philadelphia, W.B. Saunders Company.
31. Harris, L. (1978). Cited is Nandini. (1985). "Some Prosodic Aspect in Kannada". Unpublished Dissertation, University of Mysore.
32. Hird, K. (1993). "prosody and Emotion: Acoustic analysis of emotional tone in non-dominant hemisphere damaged subjects". Australian Journal of communication disorder, 21, 50-54.
33. Hutter, G.L. (1968). "Relation between prosodic variables and emotion I normal American English utterances". Journal of Speech and Hearing Research, 22, 627-648.
34. Kent, R., Netsel, R. and Abbs, E. (1979). "Acoustic characteristic associated and hearing research, 22, 627-648.
35. Ladefoged, P. (1967). "Language and language hearing series, Three areas of experimental phonetics". Oxford University Press, London.
36. Lieberman, P, Michael S.B. (1962). Cited in Belinger, D.L. (1972). "Intonation: selected readings". Penguin Books Ltd, England, 110-112.
37. Lieberman, P. (1961). "Perturbation in vocal pitch". Journal of acoustical society of America, 33, 597-603.
38. Lieberman, P. (1968). "Intonation" perception and language. Research monograph number 38, The M.I.T. Press, Cambridge, Massachusetts.

39. Lieberman, P. (1980). Cited in Cruttenden, A. (1986). "Intonation". Cambridge University Press, New York, 248-250.
40. Lowenfeld, P. (1927). Cited in Lieberman. (1968). "Speech physiology and acoustic phonetics". M.I.T. Press, Massachusetts, 104-111.
41. Manjula, R. (1979). "Intonation in Kannada - some Prosodic aspects". Unpublished dissertation, University of Mysore.
42. Majewski, W., Blasdel, R. (1969). "Influence of fundamental frequency cues on the perception of some synthetic intonation contours". Journal of acoustical society of America, 45, 450-459.
43. Martin, J.G. (1980). "Rhythmic and segmental perception are not independent". Journal of Acoustical society of America, 65, 1286-1297.
44. Minifie, F. (1973). Cited in Nandini. (1985). "Some prosodic Aspect in Kannada". Unpublished Dissertation, University of Mysore.
45. Morse, P.A. (1972). "The discrimination of speech and non-speech stimuli in early infancy". Journal of exceptional child, 14, 477-492.
46. Nataraja N.P. (1972). "An objective method of locating optimum pitch". Unpublished dissertation, University of Mysore.
47. Nataraja, N.P. (1981). "Intonation in four Indian language under five emotional conditions". Journal of AIISH, 12, 22-27.
48. Nandini. (1985). "Some prosodic aspects in Kannada". Unpublished dissertation, University of Mysore.
49. Nandyal, I. (1981). "Comparison of Intonation patterns in normal hearing and hearing impaired children". Unpublished dissertation, University of Mysore.
50. Nicolosi, L; Harryman, E; and Krescheck, J. (1978): Terminology of communication disorders, Baltimore, Williams and Wilkins, Baltimore.
51. Nithin. (1998). "Perceptual analysis of intonation in normals". Unpublished dissertation, University of Hyderabad.
52. Osgood, S., Suci, I. And Tannenbaum. (1957). "The measurement of attitude". University of Illinois Press, Illinois.

53. Pisoni, L., Saweesh. (1975). Cited in Manjula, R. (1979). "Intonation in Kannada", unpublished dissertation, University of Mysore.
54. Pisoni, D.B, Sawusch, J.R. (1975): Cited in "prosody in perception, "production and pathologies" by Freeman, J.F. in Speech, Language and Hearing, Vol. 12, Pathologies of Speech and Language, Philadelphia, W.B. Saunders Company.
55. Pike, K.L. (1945). Cited in Bolinger, D.L. (1972). "Intonation: selected readings". Penguin Books Ltd., England, 98-111.
56. Pollack, Rubenstein and Harowitz, (1960) "Communication of verbal modes of expression". Journal of speech and language research, 3, 121-128.
57. Prasad, C. (1985). "Some prosodic aspects of Hindi". Unpublished dissertation, University of Mysore.
58. Rathna, N. Nataraja, N.P., Subramanyiah, (1982). "A study of prosodic aspects of kannada language". Journal of AIISH. 12,1-6.
59. Ross, M., Duffy, R.J. (1973). "Contribution of the lower audible frequencies to the recognition of emotion". DSH abstract, 13,423-428.
60. Sapair, P. (1973). Cited in Travis, L.E. (1971). "Handbook of speech pathology and audiology". Meredith Corp. Press, New york, 49-51.
61. Savithri, S.R. (1978). "Speech and hearing sciences in Ancient India - A survey of Sanskrit literature". Unpublished dissertation, University of Mysore.
62. Schaffer, P. (1922). Cited in Prasad, C. (1985). "Some prosodic Aspects in Hindi". Unpublished dissertation, University of Mysore.
63. Schaffer, P. (1978). "Hearing words without words: prosodic cues for word perception". JASA, 63. 234-244.
64. Shepperd, R., Lane W.J. (1968). "Developmental of prosodic features in infant vocalization". Journal of speech and hearing research, 11,94-96.
65. Stark. R., Helm, N., and Albert, M. (1974). "Alphasia rehabilitation resulting from melodic intonation therapy". Cortex, 10, 303-308.

66. Steele S.A. (1965). Interaction of Fo and prosody. *Phonetica*, 43, 92-105.
67. Thorsen, N. (1978). "An acoustical investigation of Danish Intonation". *Journal of phonetics*, 6, 151-176.
68. Thurstone, P., Chave, L.W. (1927). Cited in Uldall, E.T. (1973). "Altitudinal meanings conveyed by intonation curve". 128-135.
69. Tokova, R.V., Yampolskaya. (1969). "Phonetics in linguistic a book of readings". 178-186.
70. Travis, L.E. (1971). "Handbook of speech pathology and audiology". Meredith Corporation Press, New York.
71. Uldall, E.T. (1960). Cited in Jones, W.E. and Laver, J. (1973). "Phonetics in linguistics a book of reading". 98-101.
72. Winckle, F. (1970). "Acoustical foundation in phonetics". North-Holland Publishing, Company Amsterdam.

APPENDIX - A

1. చూశారా ! ఆడిక్క చప్పుళ్ళలా కూడ కౌపం
cuus'araa ! aa Dekka cappuLLaloo kuuDa koopam

కన్పిస్తోందిరా దెవుడా !
kanpistoondiraa deewuDaa! FEAR
2. వద్దు నాయనా అల్లెరెడి విరిగింది కదా !
waddu naayanaa alreDii wirigindi kadaa! FEAR
3. రండి వెళ్ళి పాదాం .
raNDii WeLii Poodaam . FEAR
4. రాడెవెధవలండే వచ్చెస్తున్నారండే !
rawDiiwedhawalaNDii ! WacceestunnaaraNDii! FEAR
5. ఏవయ్యా గోపాలం ఇదెమైనా న్యాయంగా ఉందా ?
eevayyaa goopaalam ideemaynaa nyaayangaaa undaa ?

ఉందా అంటున్నాను !
undaa aNTunnaanuu! ANGER
6. వాడు సామాన్యుడు కాదూ .
waaDu saamaanyuDu kaaduu . ANGER
7. ఏం బాబూ! లక్షణంగా పెళ్ళి చెసుకోబోతున్న పిల్లనిలా
eem baabuu! lakSaNangaa peLLi ceesukoobootuna pillanilaa

లేవుకో బ్బెస్తావా !
leepukocceestaawaa! ANGER

- ఇట్టాంట అనాబారం నెనెక్కడో చూళ్ళాడు .
8. iTTaaNTi anaacddram neenekkaDaa cuuLLeedu . ANGER
- చాలా చక్కగా పాడవు నాయనా !
9. caalaa cakkagaa paaDaawu naayanaa! JOY
- ఆహ్లా బాగానె కనపడుతున్నావు .
10. aahhaa! BaagaaneekanapaDutunnaawu . JOY
- నా గురించి కవిత్వం రాశారు తెలుసా !
11. naa gurinci kawitwam raas' aaru telusaa! JOY
- నా తల్లె రామ్మా ! రా కూర్చో
12. naa tallee raammaa! Raa kuurcoo . JOY
- ఏ ఊరు బాబూ ?
13. ee uuru baabuu? NEUTRAL
- సందేహం లాదు ఈడు తెలుగోడే !
14. sandeeham leedu iiDu telugooDee! NEUTRAL
- అవునూ ! అర్థరాత్రి ఎటో వెళ్ళినట్టున్నారు .
15. awunuu! artharaatri eToo weLLinaTTunnaaru . NEUTRAL
- ఏం చెప్తావు నాన్నా !
16. eem ceptaawu naannaa! NEUTRAL
- మూగవాడివి కాదు నాన్నా ! నీకు మాట తప్పకుండా
17. muugawaaDiwi Kaadu naannaa! niiku maaTa tappakuNDaa
వస్తుంది .
wastundi . GRIEF

- r- 18. బాబు పరిస్థితి ఏమ్ బాగలేదు !
baabu paristhithi eemii baagaaleedu! GRIEF
19. ఆ జనంలా తనేటా తప్పిపోయాడు.
aa janamloo taneToo tappipooyaaDu. GRIEF
20. ఇంతకింత అనుభవించక పోవె.
intakinta anubhawicaka poowe. GRIEF
21. ఈ బెంగాలీ గోల తప్పింది.
ii bengalii goola tappindi. FRUSTRATION
22. ఏనటా ఈ గోల అయిన పాటే కాదు మాట కూడా
eenToo ii goola aayana paaTee kaadu maaTa kuuDaa
అర్థమయ్యి చావదు నాకు.
arthamayyi caawadu naaku. FRUSTRATION
23. నీ బూడి సలహా నా కెమి అఖరలేదు.
nii booDi salahaa naa keemi akkharleedu. FRUSTRATION
24. అంతుగాంతులెని ఇంట్లో ననాక్క క్షణం కూడా
antuugontuu leeni iNTloo neenokkaa kSaNam kuuDaa
ఉండలేను.
uNDaleenu. FRUSTRATION

25. బాబు వాళ్ళ నాన్న కాసం ఎంత బెంగపెట్టుకున్నాడో
baabu waLLa naanna koosam enta bengapeTTukunnaaDoo

ఏంటో ?

eeNToo ?

WORRY

26. మూడు సంవత్సరాల నంచి ఎంత చిత్రవధ
muuDdu samwatsaraala nunci enta citrawadha

అనుభవించానా తెల్సా !

anubhavincaanoo telsaa!

WORRY

27. పాపం ! నా కాసం ఎక్కడెక్కడ వెతుకుతున్నాడో.
paapam! naa koosam ekkaDekkaDa wetukutunnaDoo!

WORRY

28. ఇదంతా నా వల్ల జరిగింది.
idantaa naa wallee jarigindi.

WORRY

29. అబ్బ! నా కెండుకమ్మా అంత అదృష్టం.
abba! naa kendukammaa anta adruSTam.

SURPRISE

30. అర! కారిక్కడపెడితే అక్కడికెలా వెళ్ళింది?
are! KaarikkaDapeDitee akkaDikelaa weLLindi ?

SURPRISE

31. అమ్మో! ఈ కాలంలా ఎవరలాంటి వాళ్ళా నమ్మలొక
ammo! Ii kaalamloo ewarelaaNTi waaLLoo nammaleeka

పొతున్నాము.

pootunnamu.

SURPRISE

32. ఓ అడాండి! భవసాగరం అంటే కష్టాలన్నమాట.
oo adaaNDi ! bhawasaagaram aNTee kaSTaalannamaaTa. SURPRISE
33. ముఖ్యంగా మి లాంటి భాండసులు నా లాంటి మేధావులు
mukhyangaa mii laaNTi chaandasulu naa laaNTii meedhaawulu
- చెస్తున్న ఈ ప్రయోగాలు తప్పకుండా విని తీరాల.
ceestunna ii prayoogaalu tappakuNDaa wini tiiraali JEALOUSY
34. కౌతి, గీతి అనే రాస్తే అది కవిత్వం కాదు కపిత్వం!
Koti, giiti ani raastee adi kawitwan kaadu kapitwam! JEALOUSY
35. నీ కెమి రాదుపో! నీ దెగ్గర నెనెమి నెర్చుకొను.
nii keemi raadupoo ! nii deggara neeneemi neercukoonu.. JEALOUSY
36. నిన్ను నమ్మించాల్సిన అవసరం నాకేం లేదు.
ninnu nammincaalsina awasaram naakeem leedu. JEALOUSY

APPENDIX - B

Perceptual Scores in Non-Native Speakers

Emotion	Fear	Anger	Joy	Neutral	Grief	Frustration	Worry	Surprise	Jealousy
Fear									
1.	2	2		3	2	1	7	1	2
2.	4		2	1	3	1	7		2
3.	7				3	2	8		
4.	7	3	2			2	3	1	2
Anger									
1.	2	11	2	1		2			
2.	7		2			2			2
3.		6	3	2	1	2		4	2
4.	1	7		3	1	2	1	1	3
Joy									
1.		1	3	7	3		1	3	2
2.	2		12	3	3			3	
3.			5	4	4			5	2
4.	1	2	4	12			1		
Neutral									
1.	2	2		10			1	3	2
2.	2			9	1		3	1	4
3.	2	2	2	1			2	4	7
4.	1	2	1	5	3	2	5		1
Grief									
1.	3	2		1	6	2	4		2
2.	1	2	1	2	1	3	5		5
3.	5	2	3	3	1		3	1	2
4.	2	3			8	3	2		2

Emotion	Fear	Anger	Joy	Neutral	Grief	Frustration	Worry	Surprise	Jealousy
Frustration									
1.		2	1	5	5	2		2	3
2.				7	2	4	4	3	
3.	2	6	2	2		2	4		2
4.		•5	2	1	1	4	3		4
Worry									
1.	3	2	2		5		6		2
2.	2	3			4	3	3	2	3
3.		2	2	2	2	6	5	1	
4.	5	2		3	2	5	1	2	
Surprise									
1.		1	7	2	2		3	5	
2.		4		5	2		3	6	
3.	3	1	2		3	2	3	4	2
4.	1	2		3	3	2	4	4	4
Jealousy									
1.			3	7			2	5	6
2.	1			4	3	3		5	1
3.	1	2		3	2	3	3	2	4
4.		3	1	7	2	3	3		1

Perceptual Scores in Native Speakers

Emotion	Fear	Anger	Joy	Neutral	Grief	Frustration	Worry	Surprise	Jealousy
Fear									
1.	19							1	
2.	15				1				
3.	16	1				3			
4.	13		2		3	2			
Anger									
1.		20							
2.		17							
3.		13			2			2	
4.		19			3	2			
Joy									
1.			18	2					
2.			16	2					4
3.			19	1					
4.			14	9					1
Neutral									
			18						2
			16	1			1		
		1	15	2					
		1	10	6					
Grief									
1.				16	1		3		
2.				14	2		1	2	
3.				10			9	1	
4.				17	5		2		

Emotion	Fear	Anger	Joy	Neutral	Grief	Frustration	Worry	Surprise	Jealousy
Frustration									
1.				5		10	2		
2.						15	4		
3.		4		2	2	12			
4.		2				13			
Worry									
1.	2		1		2		16		
2.	1				5	2	11		
3.					5		15		
4.					6		14		
Surprise									
1.	4							15	
2.								20	
3.							1	19	
4.				3		1	1	14	
Jealousy									
1.				1				4	15
2.						1	1		14
3.						4	4		12
4.				4		4	2		10

PERCEPTUAL SCORES IN NATIVE SPEAKERS

Emotion	Fear	Anger	Joy	Neutral	Grief	Frustration	Worry	Surprise	Jealousy
Fear	78.75%	5%	10%	-	15%	5%	12.5%	5%	-
Anger	-	91.25%	-	-	15%	10%	10%	10%	-
Joy	-	-	76.25%	17.5%	-	-	-	12.5%	-
Neutral	-	-	10%	73.75%	15%	-	5%	-	10%
Grief	-	-	-	5%	71.25%	13.5%	18.75	7.5%	-
Frustration	-	15%	-	20%	10%	62.5%	15%	-	10
Worry	7.5%	-	5%	-	22.5%	10%	70%	-	-
Surprise	-	20%	5%	15%	-	5%	10%	85%	5%
Jealousy	-	-	-	12.5%	-	15%	11.6%	20%	63.75%

PERCEPTUAL SCORES IN NON-NATIVE SPEAKERS

Emotion	Fear	Anger	Joy	Neutral	Grief	Frustration	Worry	Surprise	Jealousy
Fear	25%	6.25%	5%	5%	10%	7.5%	31.25%	2.5%	7.5%
Anger	12.5%	38.75%	8.75%	7.5%	2.5%	11.25%	2.5%	7.5%	8.75%
Joy	3.75%	3.75%	30%	28.75%	12.5%		2.5%	13.75%	5%
Neutral	8.75%	7.5%	3.75%	31.25%	5%	8.75%	7.5%	10%	17.5%
Grief	13.75%	11.25%	5%	7.5%	20%	10%		18.75%	13.75%
Frustration	2.5%	10.25%	6.25%	18.75%	10%	15%	13.75%	6.25%	11.25%
Worry	12.5%	11.25%	5%	6.25%	16.25%		18.75%	6.25%	6.25%
Surprise	5%	10%	11.25%	12.5%	8.75%	5%	16.25%	23.75%	7.5%
Jealousy	2.5%	6.25%	5%	26.25%	8.75%	11.25%	10%	15%	15%

Showing the perceptual scores in percentage for different emotions in Native and Non-native Speakers

Responses

Emotion	Fear		Anger		Joy		Neutral		Grief		Frustration		Worry		Surprise		Jealousy	
	N	NN	N	NN	N	NN	N	NN	N	NN	N	NN	N	NN	N	NN	N	NN
Fear	18.75%	25%	5%	6.25%	10%	5%	5%	15%	10%	15%	12.5%	31.25%	5%	2.5%				7.5%
Anger		12.5%	91.25%	38.75%		8.75%	7.5%	15%	2.5%	10%	11.25%	10%	2.5%	10%	7.5%			8.75%
Joy		3.75%		2.75%	76.25%	30%	17.5%	28.75%	12.5%				2.5%	12.5%	13.75%			5%
Neutral		8.75%		7.5%	10%	3.75%	73.75%	31.25%	15%	5%	8.75%	5%	7.5%	10%	10%			17.5%
Grief		13.75%		11.25%		5%	7.5%	71.25%	20%	13.5%	10%	18.75%		7.5%	18.75%			13.75%
Frustration		2.5%	15%	10.25%		6.25%	20%	18.75%	10%	62.5%	15%	13.75%		6.25%	10%			11.25%
Worry	7.5%	12.5%		11.25%	5%	5%	6.25%	22.5%	16.25%	10%		70%	18.75%		6.25%			
Surprise		5%	20%	10%	5%	11.25%	15%	12.5%	8.75%	5%	5%	5%	10%	16.25%	23.75%	5%		7.5%
Jealousy		2.5%		6.25%		5%	12.5%	26.25%	8.75%	15%	11.25%	11.6%	10%	20%	15%	63.75%		15%

N - Native Speakers

NN - Nonnative Speakers