Dedicated to AMMA and DADDY

CERTIFICATE

*This is to certify that this dissertation entitled "***PROSODIC** FEATURES OF THE POST - THERAPY SPEECH OF STUTTERERS" *is*

the bonafide work in partfulfilment for the degree of "Master

of Science (Speech and Hearing)" of the candidate with register

number **M - 9507.**

Mysore
May, 1997

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CERTIFICATE

This is to certify that this dissertation entitled **"PROSODIC FEATURES OF THE POST - THERAPY SPEECH OF STUTTERERS"** *has been prepared under my supervision and guidance.*

Mysore
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DECLARATION

I hereby declare that this dissertation entitled **"PROSODIC FEATURES OF THE POST - THERAPY SPEECH OF STUTTERERS"** is the result of my own study under the guidance of Dr. Savithri S.R., Reader, Department of Speech Sciences, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier at any University for any other Diploma or Degree.

Mysore
May, 1997

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CHAPTER I

INTRODUCTION

"Speech, like many other behaviours, is occasionally produced, by all speakers with hesitations, interruptions, prolongations and repetitions. These disruptions in the fluent or forward flow of ongoing speech behaviour are termed disfluency and their frequency, duration, type, and severity vary greatly from person to person and from one speaking situation to another. Some of these speech disfluencies, particularly those which involve within word disruptions such as sound or syllable repetitions, are most apt to be classified or judged by listeners as **Stuttering"**. (Boehmler, 1958; Schiavetti, 1975; Williams and Kent, 1958; Zebrowski and Conture, 1989).

Definitions of stuttering continue to evolve with the theories and the abilities to measure various aspects of the disorder. Traditionally, most definitions are descriptions of behaviours. They are typically presented as comprehensive list of behaviours that are common to all stutterers and that differentiate stuttering from normal speech. These descriptions of verbal behaviour associated with stuttering which are included in most of the definitions are: involuntary repetitions and prolongations. For example, Stuttering is defined in the International

Classification of Diseases as "disorders in the rhythm of speech, in which the individual knows precisely what he wishes to say, but at the time is unable to say it because of an involuntary, repetitive prolongation or cessation of a sound" (WHO, 1977).

A descriptive definition of stuttering which is widely accepted was given by Wingate in 1964. He describes the term 'stuttering[1] as:

"I(a) Disruption in the fluency of verbal expression which is (b) characterized by involuntary, audible or silent, repetitions or prolongations in the utternace of short speech elements, namely; sounds, syllables and words of one syllable.

II. Sometimes the disruptions are (e) accompanied by accessory activities involving the speech apparatus, related or unrelated body structures, or stereotyped speech utterances.

III. Also, there are not infrequently (f) indications or report of the presence of an emotional state, ranging from a general condition of 'excitement' or 'tension' to more specific emotions, (g) The immediate source of stuttering is some incoordination expressed in the peripheral speech mechanisms; the ultimate cause is presently unknown and may be complex or compound".

Earlier trends were to approach stuttering as a pathognomic monolith inspite of diversity in stuttering manifestations. Increasingly this trend has changed and stuttering is no longer viewed as a unitary disorder, there exists a need to identify components that affect a child's/ adult's threshold for fluency. In recent years as the promises of behavioural and other explanations has become less attractive, interest in the motoric and linguistic phenomenon has reawakened.

Systematic enquiry into the speech production abilities of stutterers started almost 50 years ago. The impetus for this experimentation came from the general theory that stutterers were somehow physiologically inferior to normal-speaking people. This inferiority, expressing itself through one or another component of the speech act, supposedly caused stuttering. Therefore, by focussing on such dependent variables as the locus and nature of stutterers' speech breathing, stutterers' laryngeal activity, and rate of rapid, repetitive articulatory movement, researchers hoped to delineate some significant physiological deviation that would lead to the identification of the underlying cause of stuttering. The numerous studies of stutterers' speech production abilities that were conducted included the best measuring tools and

experimental

procedures available at the time. Since at that time, these devices and methodologies were primitive and not very sensitive, only meagre or inconsistent differences were detected between the stutterers and the normals tested.

The advent of new techniques of studying speech behaviour triggered off a number of investigations of stutterers' speech production abilities based on objective physiologic, aerodynamic and acoustic studies of stutterers' habitual speech patterns. Results of these investigations indicated that the stutterings produced by stutterers involved typically abnormal events in the respiratory, phonatory and articulatory systems as well as breakdowns in the coordinations of these systems.

One of the most recent concept in the research about stuttering was given by Wingate in 1980. Wingate's view of stuttering might be termed **a defect in prosodic transition to stressed syllables.** "Prosodic" refers to various suprasegmental features such as juncture, intonation patterns and stress (or accent) changes which cut across typical phonetic segments. "Transition" defect implies that stuttering is a problem of movement between sounds rather than stuttering "on" a sound. "To" means that the problem in stuttering occurs in transitions towards - not away from - the next sound. "Stressed syllable" refers to the fact that

stuttering is most inevitably associated with syllable production notably in production of the vowel in each syllable. Vowels carry considerably more acoustic energy than consonants, and the primary source of that acoustic energy is phonation. Furthermore, the effort required for vowel production is magnified in stressed syllables and these syllables are most likely to be stuttered.

It appears that the stuttering locus is a function of linguistic stress. The results of Bergmann's (1986) study indicated that stutterers showed significantly more disfluencies on the accented words than on the same words not being accented and all subjects stuttered drastically less at unstressed syllables than on stressed syllables.

Several variables effect changes on stress, the most prominent of which are pitch, intensity and duration. On the basis of clinical observations, Scripture (1925), Travis (1927) put forth the hypothesis that the speech of stutterers is "monotonous" in the sense that it exhibits reduced pitch variability even in episodes free of stuttering. Von Essen (1939) and Fernau Horn (1973) also viewed stuttering symptomatology as characterized by monotony of speech melody. Luschinger views that this reduced pitch range was attributable to some form of neuropathological defects. A few studies have aimed at

investigating the prosodic features of stutterers speech before and after therapy. Franken, Boves, Peters and Webster (1991) reported narrower F_0 range, smooth amplitude envelope, lengthened duration of the utterances and intensity variations at unexpected places. The investigators opined that the post-therapy speech of the stutterers lacked variation in prosody and sounded monotonous.

However, some studies demonstrate no significant differences between the mean and range of F_0 of stutterers and normals (Schmitt and Cooper, 1978; Horii, 1975; Bergmann, 1984). The results of these studies are equivocal and further investigations are required to strengthen the prosodic theory.

In this context, the present study was planned. It aims at investigating the prosodic aspects (specifically focussed on intonation) in the speech of stutterers before and after therapy. Specifically the intonation patterns on different sentences depicting varying emotions as recorded before and after therapy are investigated.

CHAPTER II

REVIEW OF LITERATURE

Stuttering which is a disorder showing disruption in the undulating flow of speech has long since attracted considerable interest. Over a span of many years, various researches have putforth a multitude of theories to explain stuttering.

Dalton and Hardcastle (1977) summarized the various theories of stuttering under the headings "organic" including some of the possible physical or constitutional factors. "Psychogenic" where personality traits and particularly neurotic features are given most importance; "Learned behaviour" in which anticipation, conflict and reinforcement are seen as the key factors and "evaluational" where the diagnosis of the parents play a major role.

Of late, there is a shift from the belief in "the cause" of stuttering to "causes" of stuttering. The disorder has not developed from a simple cause, but as the result of a complex interrelationship between many factors (Andrews and Harris, 1964).

One of the most recent investigations concerning the cause and nature of stuttering emphasize the role of prosody in stuttering. The view of stuttering as a defect involving

prosody was put forth by Wingate (1976) who described it as "a prosodic defect manifested as an intermittent disorder of actualizing stress increase". Thus, according to him, stuttering is a defect in the transition to stressed syllables.

Further research suggested the significance of verbal stress in stuttering. Hejna (1972) attempted to investigate the relationship between accent/stress and stuttering during spontaneous speech. In this investigation, using spontaneous speech of 18 stutterers, stuttering occurrences on accented and unaccented syllables of polysyllabic words were compared to the frequency of such syllables in the subjects' total verbal output. Statistical analysis revealed greater than expected stuttering on unaccented syllables. The findings were significant at 1% level and it was hypothesized that decreased muscle tonus required for accented syllables might account for these findings.

The question of loci and distribution of stutter events related to grammar or to prosody, i.e., the importance of stress/grammatical features has fascinated researchers since Brown's early work (1937, 1938, 1945). In his publications, Brown identified the following factors associated with the occurrence of stuttering - initial sound

(consonant vs vowel), word length, sentence position, grammatical class, word onset and word accent. Studies that followed revealed a high coincidence of stuttering events with words that are less familiar and with syllables that are stressed (Wingate, 1984; Prins, Hubbard and Krause, 1991).

Various studies have been undertaken to investigate the role of prosody/grammar in stuttering. Bergmann (1986) conducted an investigation to provide empirical evidence for the prosodic disturbance hypothesis of stuttering. In the first study, the stuttering frequency at the loci of central accentuation was examined. The appropriate accent patterns were varied by the use of different context questions so that the sentence accent fell on two different words of the same sentence. A highly significant difference in stuttering frequency between accented and not accented words was found. This was independent of the overall stuttering frequency. All the stutterers showed significantly more disfluencies on the accented words than on the same words not being accented.

In the second experiment conducted by Bergmann in the same year (1986), the predominance of stressed syllables for stuttering incidence was examined. A poem with a regular metre (iambic) was used for the material. Subjects were 13 adult male stutterers (with moderate and moderate to severe

stuttering) and six non-stutterers. Results showed that a significant difference could be confirmed; all subjects stuttered drastically less at unstressed syllables than at stressed syllables. These results strongly confirmed Wingate's hypothesis that stuttering incidence is predominantly located on stressed syllables.

These findings are refuted by one of the most recent investigations by Hubbard and Prins (1994). They investigated the effects of word frequency and syllabic stress patterns on stuttering frequency. This was evaluated using specially designed sentences read orally by 10 adult stutterers and 10 adult non-stutterers. Results revealed statistically significant differences on rank order correlation in stuttering frequency between sentences with high and low frequency words but not between sentences with regular and irregular stress patterns.

But this could be explained based on Wingate's hypothesis (1984, 1988) who emphasized the unique role of syllabic stress, maintaining that the stutterers' problems in actualizing stress can account for the stuttering tendency to occur early in sentences, on major parts of speech and on longer, accented words.

So, it can be concluded that stuttering locus is clearly a function of linguistic stress; it occurs almost

exclusively in association with stressed syllables. Linguistics stress is expressed through phonatory changes; the locus of the stress expression is in the syllable nucleus and the syllable nucleus is almost invariably a vowel.

In identifying stuttering as a transition failure, the transition in focus is the movement into a stressed vowel, i.e. the activity necessary to "develop" a stressed vowel. Sometimes the required transition is from a position of rest (as when a word begins with a vowel); more often it is a movement from another speech gesture (as when a word begins with a consonant). A linkage to segmental effects in stuttering may lie in the fact that stressed syllables and stressed vowels in particular require more precise phonatory and articulatory coordination.

There are several variables involved in effecting changes in stress, the most prominent of which are pitch, intensity and duration. So, researchers have hypothesized that stress is not the only prosodic variable that is affected in stutterers. On the basis of clinical observations, Scripture (1925) and Travis (1927) put forth the hypothesis that the speech of stutterers is "monotonous" in the sense that it exhibits reduced pitch variability even in episodes free of stuttering.

Von Essen (1939) and Fernau-Horn (1973) in another study viewed stuttering symptomatology as characterized by monotony of speech melody. Luschinger and others concluded that the stutterers' reduced pitch range was attributable to some form of neuropathological defect. Contradicting this view point, Schilling (1962) found no difference between sutterers and non-stutterers with respect to mean and range Of F_0.

Recently, a number of studies conducted with sophisticated instrumentation have demonstrated that stutterers generally do not differ significantly from other speakers in the mean and range of F_0 . One such investigation was conducted by Schmitt and Cooper (1978). The purpose of this investigation was to determine if linguistic differences exist between stuttering and non-stuttering speakers in terms of mean F_0 of the voice during oral reading. The subjects included 12 male stutterers and 12 male non-stutterers ranging from 7-12 years of age. All stutterers had been undergoing therapy for the past one year. All the stutterers had mild-moderate stuttering (based on stuttering frequency estimate) and the non-stutterers were chosen on the basis of teacher recommendations. The stutterers and non-stutterers were paired based on age, height, weight and race. The subjects were required to read

and re-read nine sentences aloud till they were instructed to stop. This was based on Bloodstein's (1975) observation that with regard to the adaptation effect, most of the reduction in stuttering that occurs in the respective oral readings of the same passage will be evident by the fifth reading. Horii (1975) noted that by selecting the same sentence for all speakers rather than voice samples of equivalent duration without respect to linguistic content, the magnitude of errors in estimating passage F_0 means was significantly reduced. The recordings were then transferred to the visicorder oscillograph to obtain a graphic representation of the speech sample. The parameters obtained/measured included (a) Mean F_0, (b) Lowest F , (c) Highest F_0 (d) Range of F_0 of speech during oral reading. The results did not reveal any consistent pattern difference between stutterers and non-stutterers with respect to the above parameters.

Statistically there was no significant difference between the stutterers and non-stutterers. Only two of the stutterers showed greater values for all the parameters than those of the matched nonstutterers.

In contrast, another study done by Healey (1982) to measure certain parameters of the speaking fundamental frequency patterns associated with stutterers' fluent

production of speech revealed a significant difference between the speech of stutterers and non-stutterers in terms of pitch range. A total of 20 subjects participated in the study (10 adult male stutterers and 10 adult male non-stutterers). The group were within age range of 16-52 years. The stutterers were classified as having mild-severe stuttering on the Iowa scale for rating stuttering severity. The subjects were required to produce sentence length declarative and interrogative utterances. These were designed so that they contained (1) emotionally neutral stimulus items; (2) all voiced consonants to allow for the fewest possible segmental SFF perturbations; and (3) monosyllabic words so that word level stress perturbations were diminished.

Analysis of the waveform data from the experimental utterances in terms of mean SFF, mean rate of frequency change, mean number of frequency shifts and range of frequencies revealed that there was no significant difference between the groups for the first three parameters. But it was observed that the nonstutterers produced a significantly greater range of frequencies than the stutterers in both utterances.

The findings of this study are in general agreement with the results of previous investigations (Travis, 1927;

Bryngelson, 1932; Adams, 1955; Schilling and Goeler, 1961; Luschinger and Dubois, 1963; Lechner, 1979; Ramig and Adams, 1981). These earlier investigations derived pitch variability data from a variety of speech contexts and conditions (eg. sustained vowels, simple declarative sentences, reading passages, speech produced in highly emotional conditions and in the presence of novel stimuli).

Attempt has been also made to investigate the VOTs and Fundamental frequency contours of stutterers and non-stutterers by Gutkin and Healey (1984). Subjects included 10 male stutterers and 10 male normal speakers and the test stimuli consisted of 2 lists of nine monosyllabic utterances. One test syllable list consisted of three voiceless stops consonants (p/t/k) whereas the other contained voiced stops (b/d/g). Each stop consonant was produced with the vowels (/i/ /a/ and /u/). All the syllables were placed within a carrier phrase in order to rule out differences in terms of speech rate and phonetic stress patterns between and within subject groups. The subjects were required to read the word lists in their normal conversational rate and manner.

VOT measures were obtained on wide-band spectrograms and four features of F_0 contours were extracted (a) Avg. F_0 at vowel onset, (b) average vowel F_0 , (c) the speed of F_0 change and (d) range of F_0 change.

Results showed that the stutterers have

(i) longer mean VOTs than normal speakers for voiceless and voiced stops.

(ii) Larger mean values for all the four parameters related to F_0 contours than normal speakers.

(iii) Statistically no significant difference for VOT, onset of F_0 , Avg. vowel F_0 and speed of F_0 change between stutterers and normal speakers (for voiceless stops).

(iv) Significant difference from normals for range of F_0 for voiceless stops (mean range for stutterers - 26 Hz; non-stutterers - 18-23 Hz).

(v) No significant difference for F_0 contours for voiced stops.

(vi) Significant difference in VOTs of stutterers and non-stutterers for voiced stops.

From all the above findings, they concluded that there are greater differences between stutterers and non-stutterers when measures of fluency are taken at the beginning rather than in the middle of the carrier phrase.

Van Riper (1982) agreed with the original findings of scripture (1925) in describing stutterers' speech as being monotonous.

A study was done by Bergmann (1984) on German speaking stutterers ranging in age from 20-54 years in order

to examine some aspects of timing irregularities in the speech of a stutterer at a suprasegmental level and investigate the monotony hypothesis. This was done using short sentences that were spoken in response to questions asked by the experimenter.

In order to investigate the monotony hypothesis, the fundamental frequency production was analyzed. The results showed a lack of significant differences between stutterers and non-stutterers when F_0 was objectively analyzed. Also, it was found that the stutterers were generally able to realize the prosodic features to the same extent as normally fluent speakers. Another experiment was done by the same author wherein they studied the aspect that stuttering location is related to stressed syllables to check that aspect of Wingate's (1976) prosodic disturbance hypothesis. The stuttering frequency was compared in two reading tasks: a fable and a poem. Results showed that in segments free of disfluencies taken from both the tasks, there were no significant differences between the mean F_0 and F_0 variability of stutterers and non-stutterers with respect to the analysis of overall stuttering frequency. A highly significant difference was found between the two different prosodic structures with less stuttering on the poem as expected. Also, it was found that the subjects stuttered

less on unstressed syllable than on stressed syllables. These findings again strongly support Wingate's hypothesis.

A few studies have aimed at investigating the prosodic features of stutterers' speech before and after therapy. These studies were based on the assumption that the speech of stutterers sounds less natural after therapy since there are lesser prosodic variations after therapy.

Stuttering therapy procedures such as rhythmic (Brady) or prolonged speech (Goldiamond, 1965) have been criticized because after therapy the subject may speak fluently but also abnormally (Boehmler, 1970; Van Riper, 1971, 1973; Sheehan, 1975). In recent years some therapy programs employing rhythmic/prolonged speech have endeavored to solve this problem by incorporating procedures to shape these speech patterns into "normal" speech (Goldiamond, 1965; Ingham, Andrews and Winkler, 1972; Perkins, 1973a; Ingham and Andrews, 1973). These procedures have for the most part provided the stutterer a combination of sustained fluency and speech-rate control. However, research designed to assess whether normal fluency has been achieved in these programs has been rare.

One study which was aimed at assessing the normalcy of speech behaviour was conducted by Ingham and Packman

(1978). This study included nine stutterers and nine normally fluent speakers, matched for age and sex as subjects. The stutterers (seven males and two females) ranged in age from 13-24 years. They were undergoing a token economy speech stuttering therapy program that incorporated a prolonged speech procedure.

Subjects were recorded for 10 minutes while conversing with another person. A 1-minute speech sample, free of identifying content was selected from the first 5 minutes of the recording. Each sample was judged as stutter-free by two clinicians. The judges were required to use three scales to judge normalcy: a prosody scale, a rate scale and a fluency scale. The judges consisting of students (none was speech language pathology student) were required to judge 1 minute speech samples from stutterers and non-stutterers.

The prosody scale required listeners to judge each sample as either (1) exceptionally monotonous, (2) monotonous, (3) expressive or (4) exceptionally expressive. Similarly a rate scale, fluency scale, natural/ unnatural and stutterer/normal judgements were obtained from different group of listeners.

For comparison, the Mann-Whitney 'U' test with a two tailed test of significance was used and it was found that

of the five judgement scales, only normal/stutterer scale resulted in significant differences between the two groups with the stuttering samples receiving fewer "normal" speaker judgements. This suggests that although the stutterers in this study achieved speech that resembled normal speech in a number of ways, their speech still retained features that caused listeners not to regard them as normal speakers.

One of the most popular studies on prosodic features of stutterers after therapy was by Franken, Boves, Peters and Webster (1991). In their study, four severe male stutterers (mean age 32.4) were recorded before and just after following a Dutch adaptation of the Precision Fluency shaping program (Webster, 1974). In both conditions, they produced 20 utterances one at a time and the same were produced by two non-stutterers.

Both perceptual and acoustic analysis were done. Perceptual analysis required two clinicians to judge the utterances as fluent or not fluent. Acoustic analysis consisted of inspection of displays of the oscillogram, the F_0-contour and the amplitude envelope.

The following features were observed during acoustic analysis of the post-therapy utterances:

a. a much narrower F_0 range and a smoother amplitude envelope

b. lengthened overall duration of the utterances
c. prolonged VOTs
d. narrower range of amplitude envelope
e. occurrence of intensity variation at unexpected places.

When the trained expert raters who were not informed of the identity of the speakers, made perceptual judgements of the 20 utterances of the stutterers and non-stutterers, it was found that the post-therapy speech of all four stutterers contained traces of the therapy speech targets such as:

a. gentle voice onsets and extremely controlled
b. phonatory behaviour
c. reduced coarticulation
d. overall reduced rate

These findings have been summarized by saying that the post-therapy speech of the four stutterers lacked variation in prosody and sounded monotonous.

The review indicates equivocal view on the prosodic features of stutterers. The present study aims to investigate the prosodic features of stutterers before and after therapy and compare it with normals.

CHAPTER III

METHODOLOGY

The methodology consists of two parts:

A. Acoustic task

B. Perceptual task

A. Acoustic task

i. Subjects: Ten adult male stutterers served as subjects for the investigation. The stutterers were selected based on the diagnosis made by an experienced speech language pathologist, the details of which are provided in Table I.

Subjects	Sex	Age in years	% dysfluencies		Number of sessions (practice in hours)	Technique
			Before therapy	After therapy		
S_1	M	23	18.47	2.38	20 (80)	Modified air flow
S_2	M	18	36.67	3.33	5 (20)	Modified air flow
	M	19	30	0	9 (36)	Prolongation
S_3	M	17	2.6	0	18 (72)	Modified air flow
S_4	M	25	31	0	8 (32)	Modified air flow
S_5	M	29	11.8	0	15 (6)	Prolongation and finger-thumb opposing
S_6	M	25	26.08	14.8	11 (44)	Modified air flow
	M	25	11.5	6.18	12 (48)	Prolongation
	M	19	12.0	4.0	10 (40)	Prolongation
S_7	M	25	40.5	16.7	10 (40)	Prolongation

Table I: Subject details

S_8

S_9

S_{10}

ii. Material: Test material consisted of ten sentences in Kannada uttered by a normal speaker. The sentences were expressive of eight different emotions such as anger, command, sarcasm, question, request, surprise-question, statement and surprise-statement. The sentences consisted of two statements and two commands apart from one sentence in each of the other emotions. These sentences were written one each on a card with the intended emotion, on the top right hand side of the card. These were visually presented to a 47-year old Kannada speaking normal female. She was instructed to utter the sentences in the intended emotion into a microphone placed at a distance of 10 cms from the mouth. All the sentences were played back to the speaker and if she felt that she had not uttered in the intended emotion, she could repeat it. After this process, all the sentences were audio-recorded which formed the material for acoustic analysis. The sentences with the intended emotions are in Table II.

Test sentences	Emotion
1. na:nu pustaka o:dide	Statement
2. kurci :nalli ku:tko	Command
3. a:haha: e:nu kli:na:gidyo:	Sarcasm
4. svalpa sumnirtiya:?	Anger
5. pa:tha baridya	Question
6. di:pa ha:ki svalpa	Request
7. sasi: duddilde: ho:tlalli tindna	Surprise question
8. u:sa: munnu:ru kilo:mi:tar o:dadlante	Surprise statement
9. janaru no:ta no:di manege: ho:dru	Statement
10. i: pustaka:nalli tegididu	Command

Table II: Material used for the study

iii. Method

The subjects were seated in a quiet environment and were explained about the task. They had to listen to each of the sentences spoken by the normal speaker and then repeat it with the same intonation pattern into a microphone kept at a distance of 10 cms from their mouth. All these were audio recorded onto an audio cassette. This procedure was repeated with the same group of stutterers before and after they underwent therapy for stuttering.

iv. Analysis

In order to compare the prosody of stutterers' speech with that of non-stutterers, the following acoustic analysis was performed.

The recorded sentences were transferred to the computer memory with a 12 bit A/D converter at 16000 Hz sampling rate. The programmes ANALYSIS and F_0 EDIT developed by the Voice and Speech Systems, Bangalore were used to extract the following parameters.

a. Fundamental frequency parameters

(i) Mean fundamental frequency: It refers to the average F_0

(ii) Maximum (absolute) fundamental frequency: It refers to the peak F_0

(iii) Absolute minimum fundamental frequency: It refers to the lowest F_0.

(iv) Absolute range of fundamental frequency: It refers to the difference between maximum and minimum F_0 .

(v) Effective maximum fundamental frequency: It refers to the maximum F_0 in the remaining 90% that is measured after truncating the upper and lower 5%.

(vi) Effective minimum fundamental frequency: It refers to the minimum F_0 in the remaining 90%

that is measured after truncating the upper and lower 5%.

(vii) Effective range of fundamental frequency: It refers to the difference between effective maximum F_0 and effective minimum F_0 .

(viii) Psigma F_0 : It refers to the standard deviation of the F_0 value.

b. Intensity parameters

(i) Mean intensity: It refers to the average intensity,

(ii) Absolute maximum intensity: It refers to the peak intensity,

(iii) Absolute minimum intensity: It refers to the lowest intensity.

(iv) Intensity range: It refers to the difference between the highest and lowest intensities.

c. Temporal parameter

Sentence duration: It refers to the total duration for which the utterance was spoken.

d. Voicing parameters

(i) % voiced

(ii) % unvoiced

The above parameters were obtained for all the ten sentences for all the speakers (model and the stutterers before and after therapy).

Statistical analysis

The data was tabulated. The F_0 , Absolute minimum F , Absolute Maximum F_0 , Effective maximum F_0, Effective minimum F_0 , Maximum F_0 , Minimum F_0 were scaled, i.e. the lowest among the measure for each subject was the reference and the other values were calculated with reference to this. Sign was also considered. T-test was used for comparison of the acoustic parameters of model, pre- and post-therapy utterances in order to evaluate the presence of any significant difference.

B. Perceptual task

Material: Using the tape transfer mechanism each sentence as uttered by the model was recorded which was followed by the same sentence as uttered by the stutterer before and after therapy. Thus, for each subject, the ten model sentences were followed by the same sentences as uttered by the stutterer before therapy and the model sentences again followed by the same sentences as uttered by the stutterer after therapy. These were transferred and audio recorded. In total, for ten subjects, 200 sentences were audio-recorded which formed the material.

Subjects: Three trained listeners, who were studying the Master's course in speech and hearing in the age range of 20-25 years served as subjects.

Method: The subjects were instructed to listen to the cassette and were to indicate whether the sentences as uttered by the stutterer sounded similar/dissimilar to the model in terms of the intonation patterns. If similar, they were to mark it by the letter 'S' and if not, by the letter 'D' on the response sheet provided.

Analysis

The percent same/different was computed for each subject and for each sentence, Correlations were obtained to compare the perceptual analysis of the model utterances with the samples of the stutterers' utterances before and after therapy.

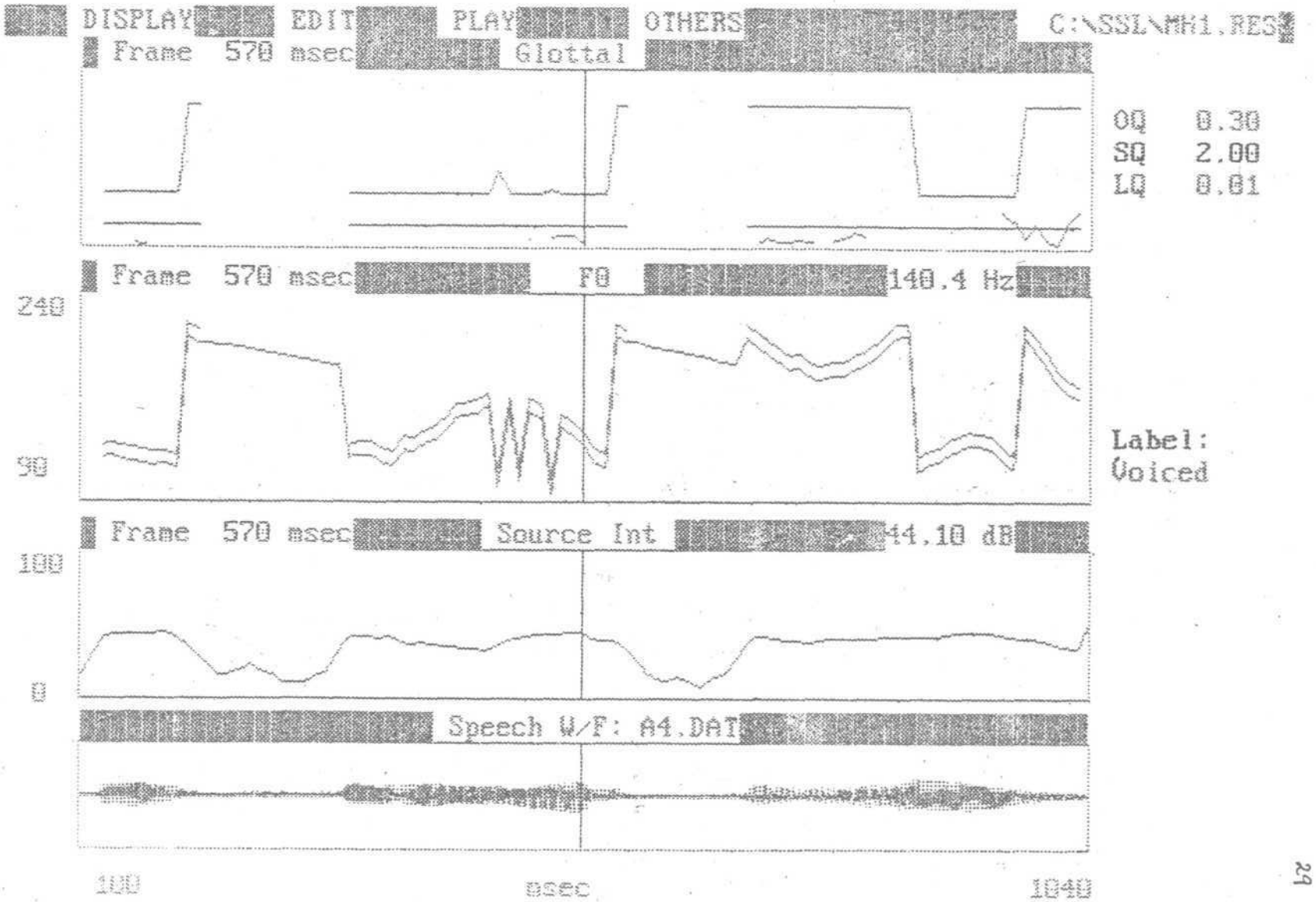

FIGURE M_1 : WAVEFORM OBTAINED FOR THE FOURTH SENTENCE (MODEL'S)

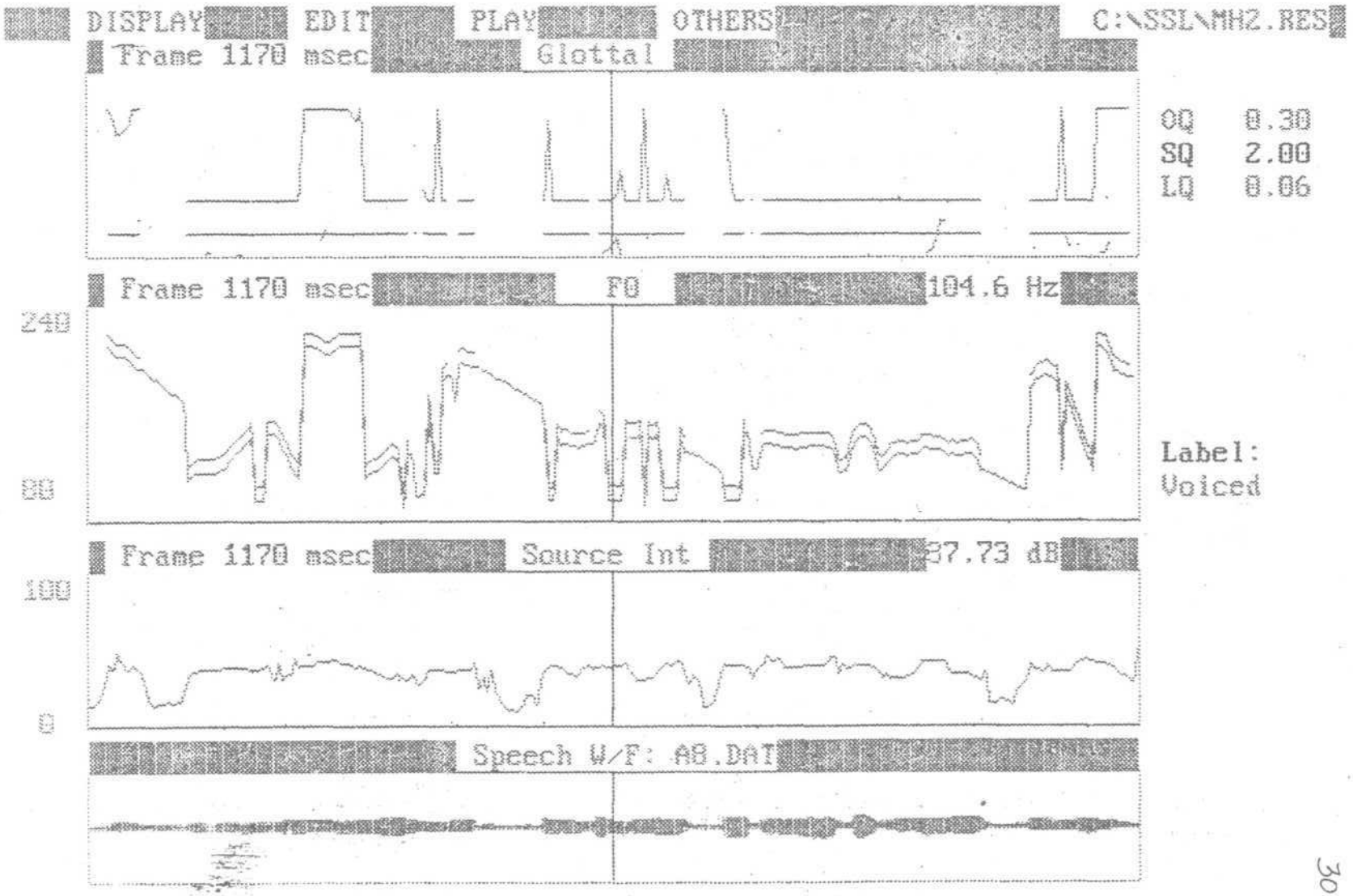

FIGURE M_2 : WAVEFORM OBTAINED FOR THE EIGHTH SENTENCE(MODEL)

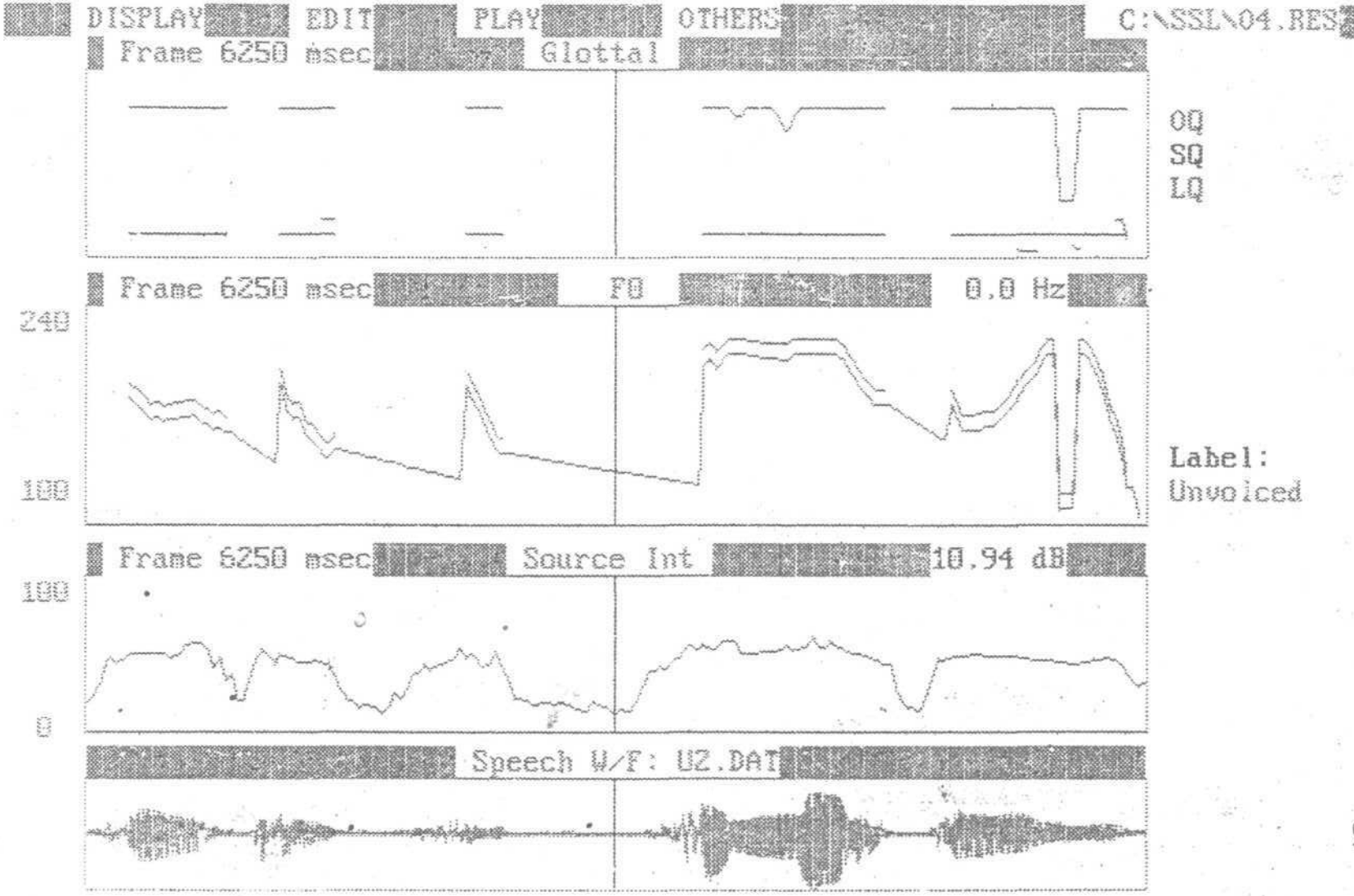

FIGURE A_1: WAVEFORM OBTAINED FOR THE FOURTH SENTENCE (PRETHERAPY)

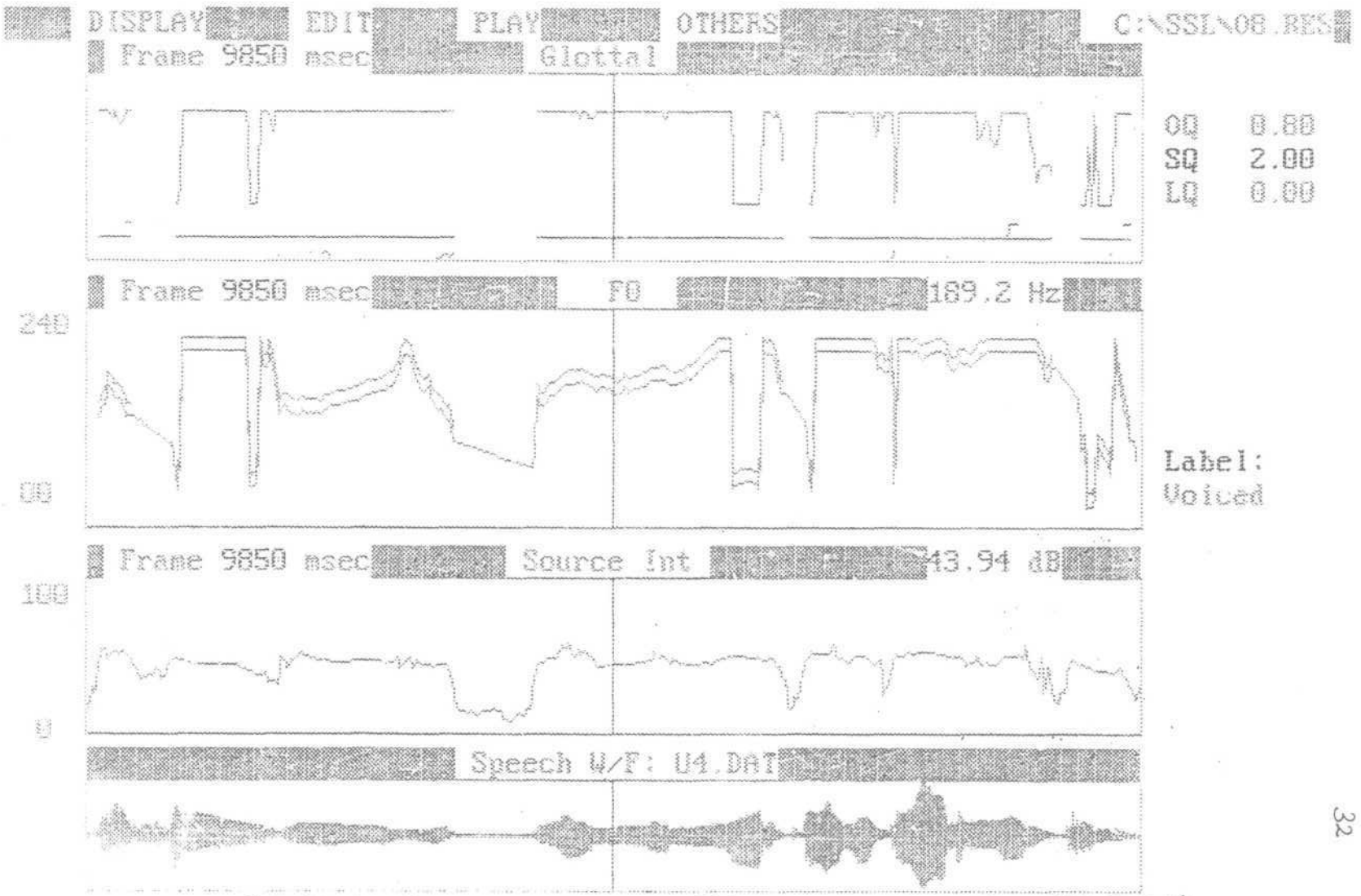

FIGURE A_2 : WAVE FORM OBTAINED FOR THE EIGHTH SENTENCE (PRE THERAPY)

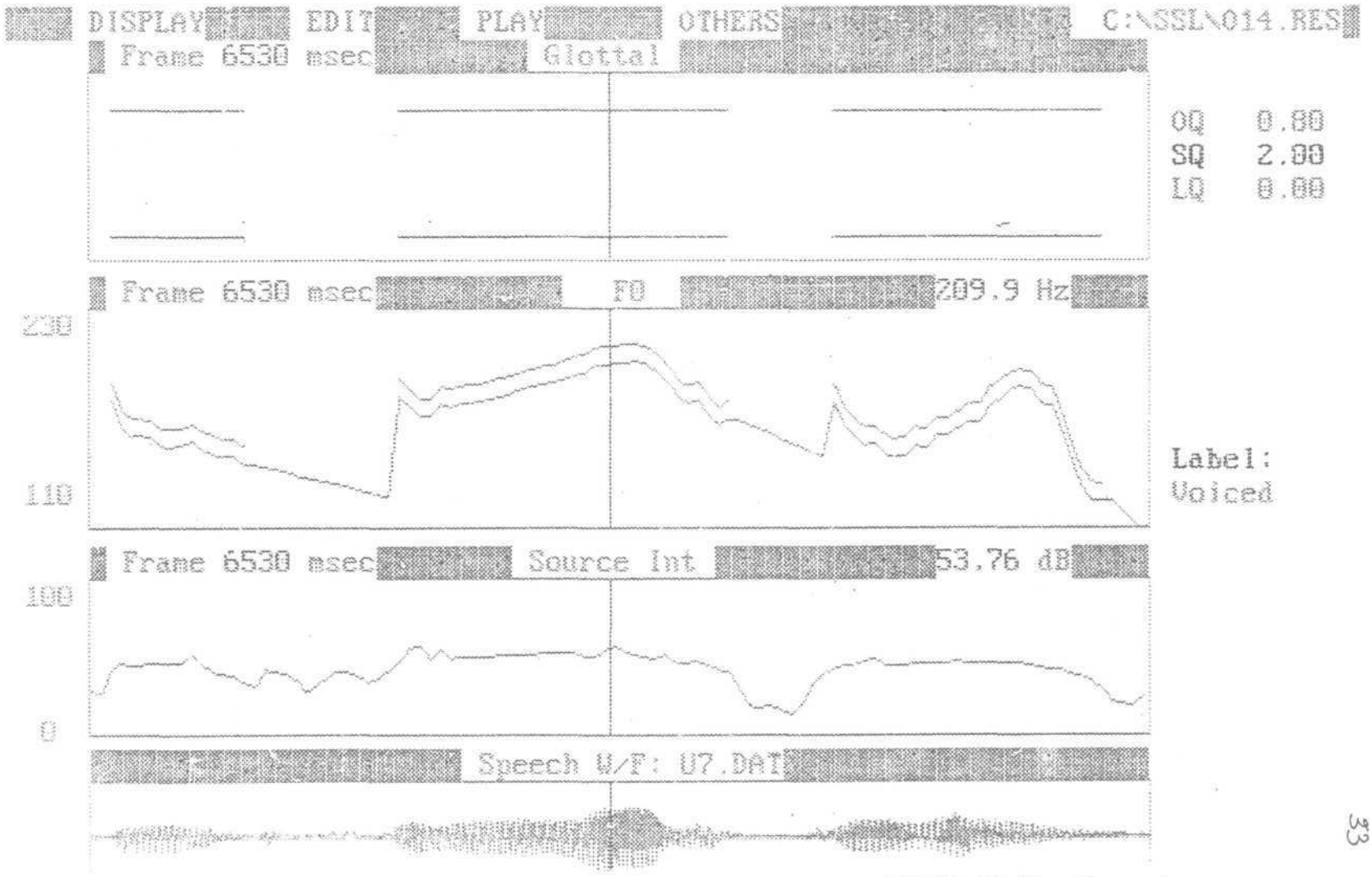

FIGURE B1: WAVEFORM OBTAINED FOR THE FOURTH SENTENCE (POST THERAPY)

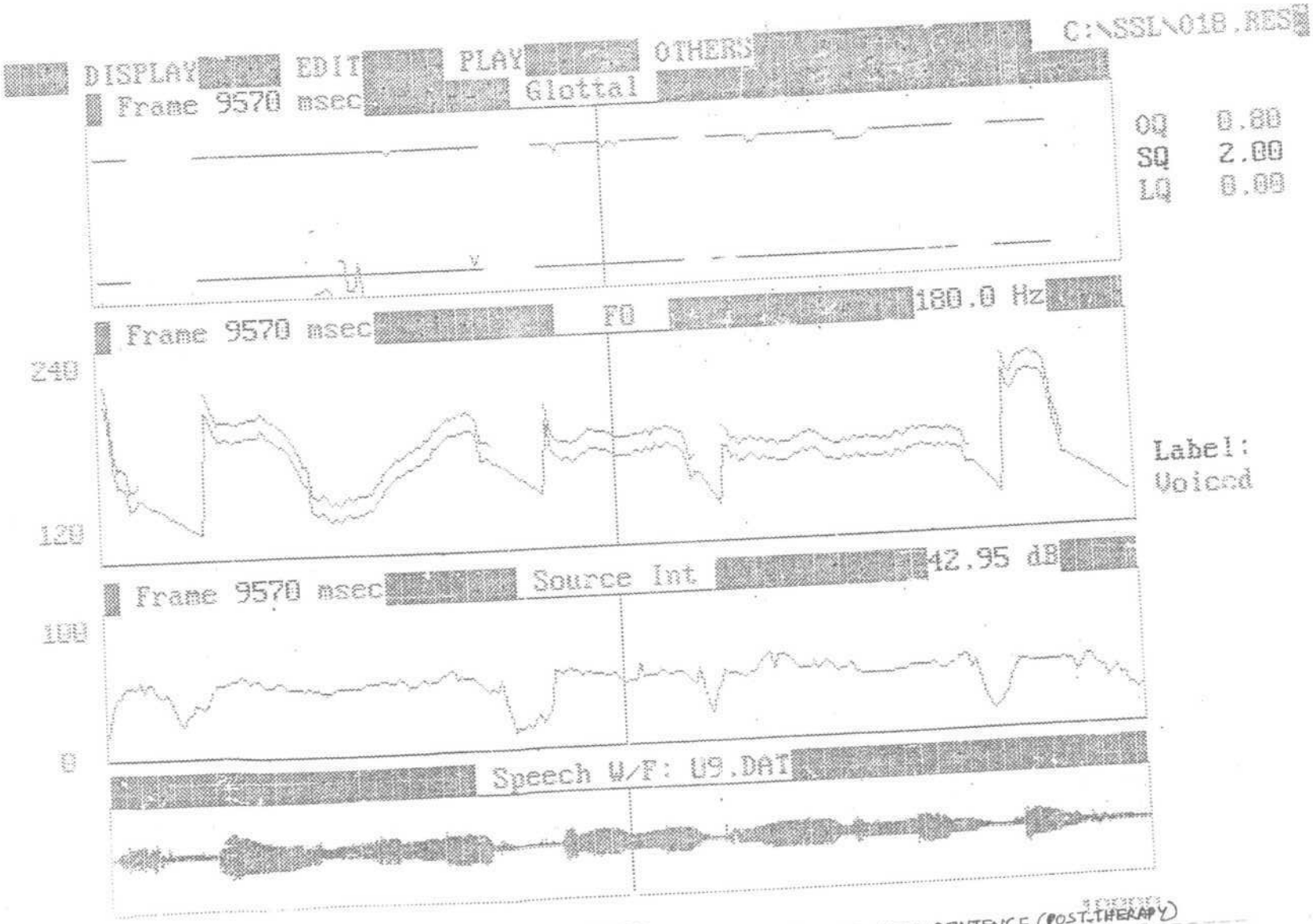

FIGURE B_2: WAVEFORM OBTAINED FOR THE EIGHTH SENTENCE (POST-THERAPY)

CHAPTER IV

RESULTS AND DISCUSSION

RESULTS

A. Acoustic analysis

Acoustic analysis of the following were subjected to T-test to study the presence/absence of a significant difference -

(i) Model vs. pre-therapy

(ii) Model vs. post-therapy

(iii) Pretherapy vs. Post-therapy

All the above utterances were analysed in terms of fundamental frequency parameters, intensity parameters, temporal parameters and voicing parameters.

I. Model vs. Pretherapy

1. F_0 related parameters

It was observed that the Absolute maximum and minimum F_0 , Effective minimum and maximum F_0 , Mean F_0 , the Absolute and Effective range of F_0 and Psigma of F_0 were higher in the model compared to stutterers. However, significant differences were found between the Mean F , Absolute range of F_0, Effective maximum F_0 and Psigma F_0 of the model and the stutterer. Also, the standard deviations were greater in the model compared to stutterers.

2. Intensity related parameters

The Mean intensity, Absolute maximum intensity and Intensity range were higher in the model compared to stutterers. Also, standard deviations were greater in the model. However, no significant differences were observed between the measurements of the model and the stutterers except for the Absolute minimum intensity.

3. Voicing related parameters

No significant differences were noticed between the model and stutterers' speech. However, the percent voiced was lower, and the percent unvoiced was higher in stutterers compared to the model. Also, the model had higher standard deviations.

4. Temporal related parameters

T-test indicated significant difference between the sentence durations of the model and the stutterers with stutterers showing longer durations. Table III shows the measurements for all the parameters and figures 1 and 2 show the parameters that are significantly different between the model and the stutterers before therapy.

Sl. No.	Parameters	Model Mean	Model SD	Pre-therapy Mean	Pre-therapy SD	Significant difference
F_0 related						
1	Mean F_0	29.17*	7.35	8.706*	0.651	+
2	Abs MaX F_0	55.60*	13.83	40.9*	5.69	-
3	Abs Min F_0	34.3*	5.95	15.3*	1.82	-
4	Abs Range F_0	156.1	12.08	99.6	6.815	+
5	Eff Max F_0	49.7*	11.86	17.6*	1.59	+
6	Eff Min F_0	25.14*	9.189	16.46*	2.025	-
7	Eff Range F_0	128.31	10.32	53.54	2.37	-
8	Psigma F_0	15.9	3.43	6.5	0.622	+
Intensity related						
1	Mean intensity	9.11*	1.31	7.00*	0.466	—
2	Abs Max Int	10.87*	2.1	6.88*	0.572	-
3	Abs Min Int	3.09*	0.639	5.75*	0.453	+
4	Intensity range	45.56	1.88	43.02	0.719	-
Voicing related						
1	% voiced	25.93	3.86	20.3	1.5	
2	% unvoiced	17.57	3.93	19.9	1.45	-
Temporal						
1	Sentence duration	1350.2	170.7	2294.02	164.9	+

Table III : Mean and SD of various parameters of the utterances by the stutterers before therapy

* - Indicates that they are not the raw values but are the scaled values.

+ - Significant difference present

- - Significant difference absent

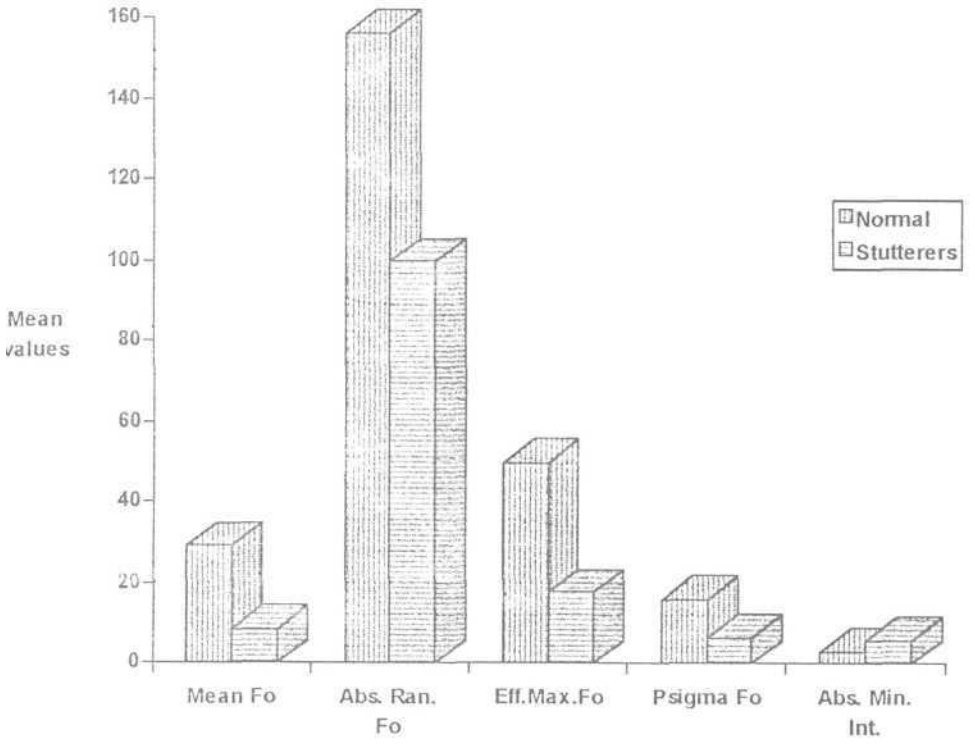

Figure 1. Fo and Intensity measures of Normals and Stutterers. (Before therapy)

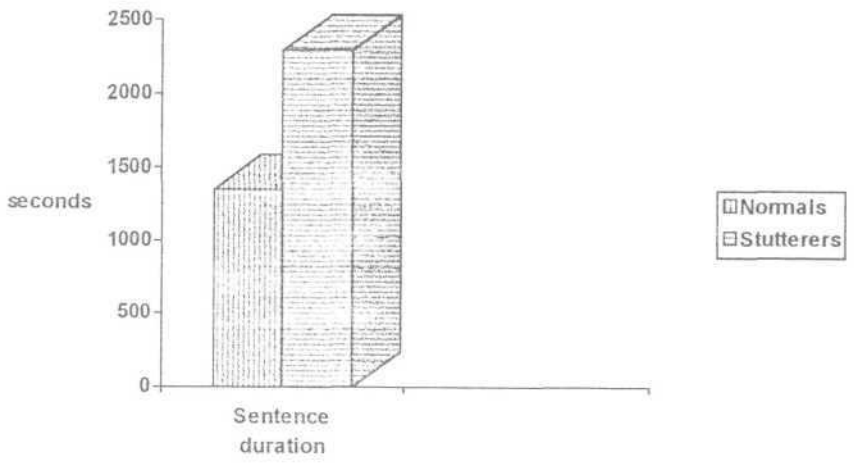

Figure 2. Temporal measure of Normals and Stutterers (Before therapy)

II. Model vs. Post-therapy

1. F_0-related parameters: The mean of all the F_0 related parameters were higher in the model compared to stutterers. Higher SDs were also observed in the model- Significant differences were found between the mean F_0 , effective maximum F_0 and Psigma F_0 of the model and the stutterers.

2. Intensity related parameters: Among these, the mean intensity and the absolute minimum intensities were significantly different between the model and the stutterers with higher mean intensity and lower minimum intensities in the model. Also, the Intensity range was wider in the model though not significantly.

3. Voicing related parameters: Percent voiced and percent unvoiced were higher among the stutterers, though not significantly.SDs were higher in the model.

4. Temporal parameters: The mean sentence durations were significantly longer in stutterers and the SDs were higher in the model. Table IV shows the mean and SD for all the parameters and figures 3 and 4 show the mean values of the model and stutterers (post-therapy) for parameters significantly different.

Sl. No.	Parameters	Model Mean	Model SD	Post-therapy Mean	Post-therapy SD	Significant difference
F_0 related						
1	Mean F_0	29.17*	7.35	10.76*	0.862	+
2	Abs Max F_0	55.60*	13.83	31.05*	3.56	—
3	Abs Min F_0	34.30*	5.95	10.50*	1.5	-
4	Abs Range F_0	156.1	12.08	96.20	4.43	-
5	Eff Max F_0	49.70*	11.86	19.55*	2.03	+
6	Eff Min F_0	25.14*	9.189	20.80*	2.24	-
7	Eff Range F_0	128.31	10.32	59.23	2.22	-
8	Psigma F_0	15.9	3.43	6.9	0.54	+
Intensity related						
1	Mean intensity	9.11*	1.31	8.520*	0.89	+
2	Abs Max Int.	10.87*	2.1	5.990*	0.53	-
3	Abs Min Int.	3.09*	0.639	7.250*	0.58	+
4	Intensity range	45.56	1.88	40.85	0.787	-
Voicing related						
1	% voiced	25.93	3.86	27.61	1.81	—
2	% unvoiced	17.57	3.93	20.40	1.68	—
Temporal						
1	Sentence duration	1350.2	170.7	2206.4	153.6	+

Table IV: Mean and SD of various parameters of the model and stutterers (post-therapy)

* - Scaled values

+ - Significant difference present

- - Significant difference absent

Pre-therapy vs. post-therapy (stutterers)

1. F_0 related parameters

It was observed that the Absolute maximum F_0 , Absolute minimum F_0 and Absolute range of F_0 values were

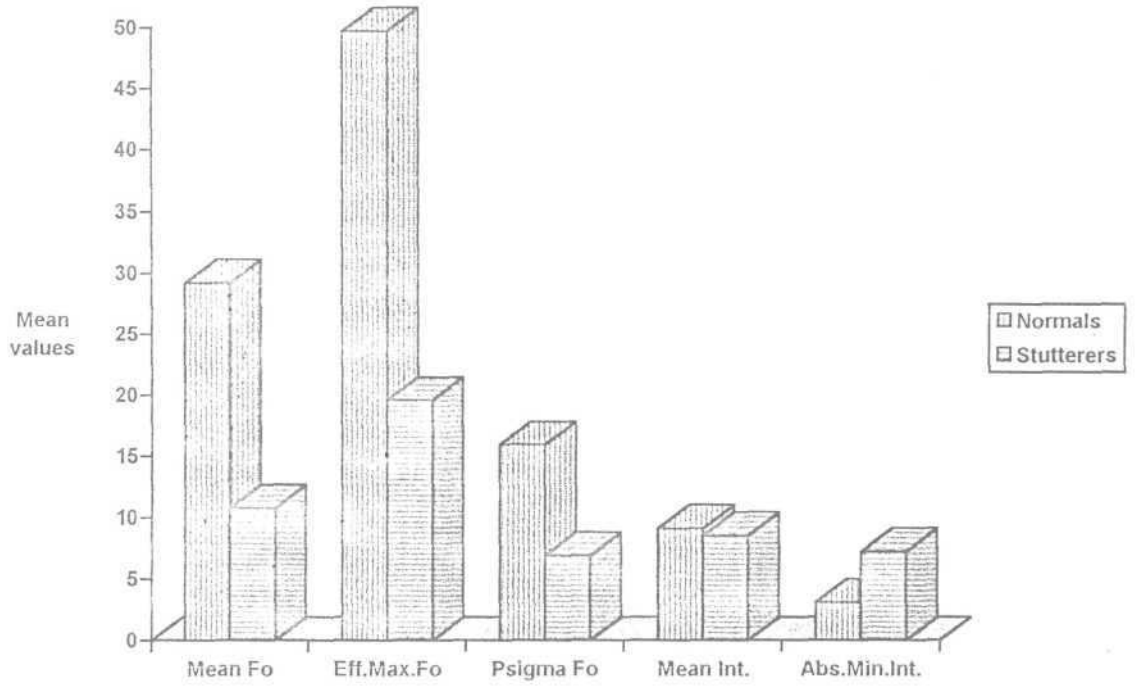

Figure 3. Fo and Intensity measures of Normals and Stutterers (After Therapy).

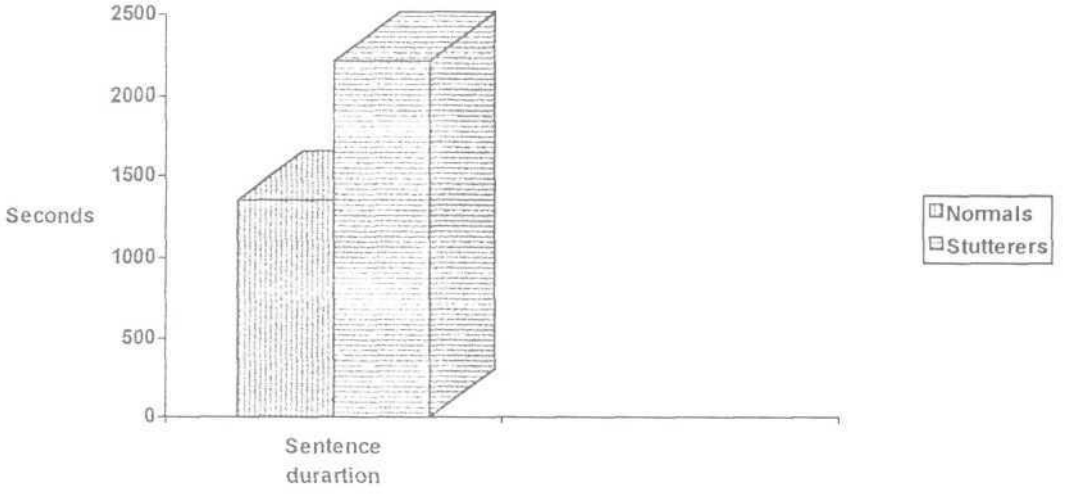

Figure 4. Temporal measure of Normals and Stutterers (After Therapy).

higher for the pretherapy utterances than for the post-therapy utterances and effective maximum F_0 , effective minimum F_0 and effective F_0 range were higher for the post-therapy utterances. However, only mean F_0 and absolute minimum F_0 showed significant differences for the pretherapy and post-therapy utterances.

2. Intensity related parameters

The Mean intensity and Absolute minimum intensity values for the pre-therapy utterances were lower than those of the post-therapy utterances while the Absolute maximum intensity and Absolute range of intensity were higher for the pre-therapy when compared to the post-therapy utterances. However, only the absolute minimum intensity value of pretherapy utterances showed a significant difference from that of the post-therapy utterances.

3. Voicing-related parameters

The % voiced and % unvoiced were lower in the pre-therapy utterances when compared to that of the post-therapy utterances. However, a significant difference was noticed for the % voiced of pretherapy utterances and post-therapy utterances.

4. Temporal parameter

It was observed that the sentence duration of stutterers before therapy was longer than that after therapy. However, this was not significantly different. Table V shows all the values obtained in the pre- and post-therapy samples.

Sl. No.	Parameters	Pre-therapy Mean	Post-therapy Mean	C.C.	Significant difference
F_0 related					
1	Mean F_0	8.69 *	10.76*	0.5287	+
2	Abs Max F_0	40.75*	31.05*	0.0250	-
3	Abs Min F_0	14.90*	10.55*	0.2086	+
4	Abs Range F_0	99.73	96.21	0.3668	-
5	Eff Max F_0	17.40*	19.55*	0.3070	-
6	Eff Min F_0	16.58*	20.84*	-0.0382	-
7	Eff Range F_0	53.37	59.23	0.1515	-
8	Psigma F_0	6.50	6.90	0.1873	—
Intensity related					
1	Mean intensity	7.01 *	8.52*	0.2925	-
2	Abs Max Int.	6.86 *	5.99*	0.05	-
3	Abs Min Int.	5.749*	7.25*	0.132	+
4	Intensity range	43.03	40.85	-0.2007	-
Voicing related					
1	% voiced	20.73	27.61	0.2103	+
2	% unvoiced	19.75	20.42	0.4064	-
Temporal					
1	Sentence duration	2300.52	2206.49	0.7517	—

Table V : Mean and correlation coefficient values of various parameters of pre- and post-therapy utterances

* - Scaled values

+ - Significant difference present

- - Significant difference absent

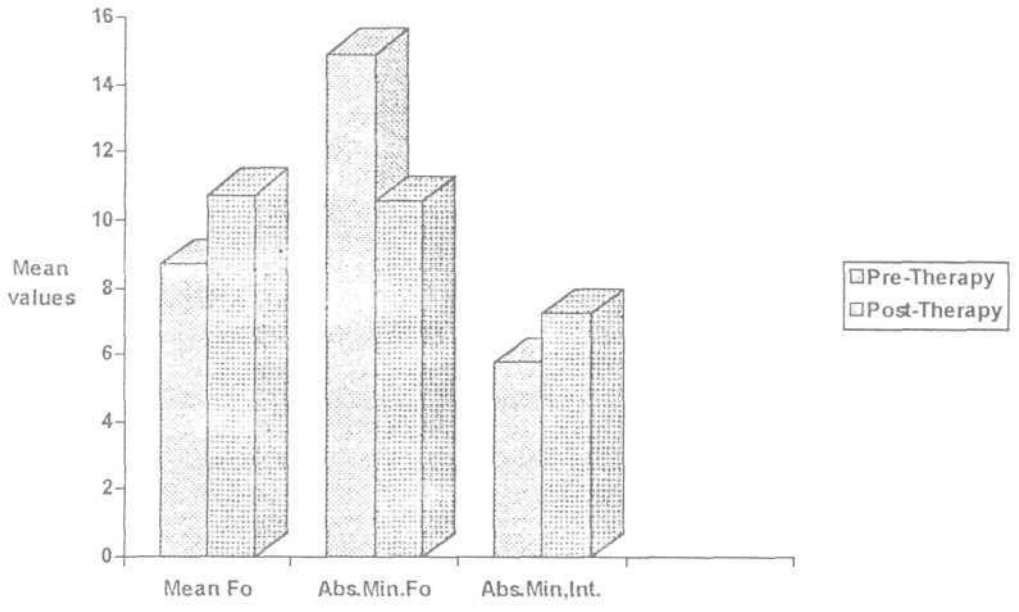

Figure 5. Fo and Intensity measures of Pre-Therapy and Post-Therapy Stutterers.

B. Perceptual evaluation

It was observed that Judge 1 perceived most of the pre-therapy utterances as similar to the model's when compared to the post-therapy utterances. But sentences 1, 3, 4 and 8 uttered after therapy were perceived more similar to model's than those uttered before therapy. In general, Judge 1 perceived 75% of the pre-therapy and 75% of post-therapy utterances as having the same intonation pattern compared to the model.

Judge II perceived all the post-therapy utterances (except sentences 4 and 5) as being more similar to the model's when compared to the pre-therapy utterances. On the whole, according to Judge II, only 70% of the pre-therapy utterances were similar to the model's while 86% of the post-therapy utterances were similar to the model's utterances.

Judge III perceived four of the pre-therapy utterances as being more similar to the models as when compared to the post-therapy utterances (sentences 1, 7, 9 and 10) and four of the post-therapy utterances as being more similar to the models when compared to the pretherapy utterances (sentences 2, 5, 6 and 8). On the whole, Judge III perceived 72% of the pre-therapy and 70% of the post-therapy utterances as similar to the models utterances. Table VI shows the percent same for all the sentences as evaluated by the three judges.

Sentences	J_1		J_2		J_3	
	A	B	A	B	A	B
S_1	70	80	40	80	90	80
S_2	90	80	70	90	80	90
S_3	50	60	90	80	30	30
S_4	70	90	80	80	70	70
S_5	80	70	70	80	70	80
S_6	70	70	60	90	70	80
S_7	70	60	60	90	80	60
S_8	70	80	70	80	50	60
S_9	90	80	80	100	90	70
S_{10}	90	80	80	90	90	80
Average	75	75	70	86	72	70

Table V : Percent pre- and post-therapy utterances perceived as same to that of the model utterances by three judges

Where J_1 , J_2, J_3 = judges

A - Pre-therapy utterances; B - Post-therapy utterances

A positive correlation was found between J_1 , J_2 and J_2 , J_3 for the perceptual analysis of the pre-therapy utterances and the model and between J_1. and J_3 for the perceptual analysis of the post-therapy utterances and the model. Table VII shows the correlations.

	J_1 vs. J_2	J_2 vs. J_3	J_3 vs. J_1
Pre-therapy	0.619	0.448	-0.18
Post-therapy	0	0.283	0.54

Table. VIII: Intra-judge correlations

DISCUSSION

The results reveal several points of interest which are summarized in Table VIII. in the table the parameters having significant differences and its nature (higher or lower) are indicated.

First, the results indicate that the F_0 range and sentence duration showed significant differences between the utterances of the model and the pretherapy stutterers. The F_0 range of the stutterers was considerably lesser when compared to the model. This finding is in consonance with most of the studies conducted on the pitch variability of stutterers as when compared to normals. All these studies revealed that stutterers have reduced pitch variability when compared to normal speakers (Scripture, 1925; Travis, 1927; Bryngelson, 1932; Adams, 1955; Schilling and Goeler, 1961; Luschinger and Dubois, 1963; Lechner, 1979; Ramig and Adams, 1981; Healey, 1982; Gutkin and Healey, 1984). However, these results contradict the findings of an investigation

Paramet er	Model vs. pre-therapy		Model vs. post-therapy		Pre-therapy vs. post-therapy		Pre-therapy	Post-therapy
	Sig. diff	Model	Sig. diff	Post-therapy	Sig. diff	Pre-therapy		
1. Mean F_0	+	High	+	Low	+	Low	Low	High
2. Abs. Range F_0	+	High	--		--		-	-
3. Effective Max. F_0	+	High	+	Low	--		-	-
4. Psigma F_0	+	High	+	Low	--		-	-
5 Abs. min. intensity	+	Low	+	High	+	Low	Low	High
6. Mean intensity	--		+	Low	--		-	-
7. Abs. min F_0	--		+	Low	--		High	Low
8. % voiced	--		-		+	High	-	-
9. Sentence duration	+	Short	+	Long	+	Short	Long	Short

Table VIII:. Summary of results

conducted by Bergmann (1984) wherein no significant differences were found in F_0 variability of stutterers and non-stutterers.

Second, the mean sentence duration of the stutterers was significantly larger than that of the model speakers. Although there have not been any investigations reported on the comparison of this particular aspect, it could be attributed to difficulty experienced by the stutterer in uttering a sentence with the required intonation pattern due to lack of coordination between the phonatory articulatory systems (Wingate, 1976).

Third, it **was found that Psigma F_0 and the sentence durations of the speech of post-therapy stutterers was significantly different from that of the model utterances.** While Psigma F_0 of the stutterers was considerably lower, the sentence duration was longer than the model utterances. This contradicts the results of Schmitt and Cooper (1978). They compared the normal utterances with the speech of post-therapy stutterers and did not find any significant differences between the two groups for the F_0 related parameters. The above results indicate that even after therapy, the stutterers' speech is different from that of the non-stutterers and hence, it may be argued that the therapy procedure has not brought about the required normalcy in the speech of stutterers in terms of prosody.

Fourth, significant differences existed between the prosodic aspects of stutterers before and after therapy in the % voiced which was considerably higher in the post-therapy speech. Although sentence duration of stutterers is not significantly different before and after therapy, the mean sentence duration is considerably shorter in post-therapy speech of stutterers. The above findings are in contradiction to the findings of the investigation by Franken, Boves, Webster and Peters (1991) who reported a reduced co-articulation and prolonged sentence duration in the post-therapy speech of stutterers when compared to pre-therapy speech. The findings of the present investigation indicate an improved overall ability in temporal durations.

Fifth, from the results of Perceptual Evaluation, it was observed that atleast 70% of the pretherapy utterances were judged as being the same as the model utterances in terms of intonation by all the three judges and atleast 70% of the post-therapy utterances were judged as being same as the model utterances in terms of intonation by all the three judges. Thus, though stutterers seem to lack an ability to produce utterances using normal intonation patterns, this problem is not generalized to all the utterances.

There was not much difference observed in the intonation patterns of the pre-therapy and post-therapy

utterances as judged by Judges II and III. But the pre-therapy utterances were judged to be considerably better than the post-therapy utterances by Judge II (J_2) indicating the effect of prolongation technique on the prosodic parameters. However, the overall results of the study lacks considerable evidence to support the notion that the use of techniques such as prolongation or rhythmic speech for stuttering therapy leads to unnaturalness in the speech of stutterers as predicted by Ingham and Packman (1978) which might be true only for programmed therapy techniques.

To summarise, the results of this study has shown that the pre- and post-therapy speech of ten stutterers who underwent prolongation therapy significantly differed in various prosodic parameters from the speech of the normals. Specifically stutterers showed less prosodic variation (reduced F_0 range) and reduced temporal coordination (longer sentence durations), i.e. their speech was associated with monotony. However, the results do not support the notion that the prolongation technique brings about a change in the prosodic aspect of the speech of the stutterer. In contrast, the reduced sentence duration in the post-therapy speech was not significant. Also, individual variations may be possible and prolongation therapy may induce significant prosodic changes such as prolonged durations and reduced F_0 range in

selected stutterers which may not be generalized to the stutterring population as a whole.

It is suggested that other aspects of prosody such as stress and rhythm be studied in the post-therapy speech of stutterers. Further, stutterers with same severity could be considered so that they can be compared.

CHAPTER V

SUMMARY AND CONCLUSIONS

The present study was aimed at investigating the prosodic aspects (specifically intonation) in the speech of stutterers before and after therapy. Specifically the intonation patterns of different sentences depicting various emotions recorded before and after therapy were investigated.

The subjects consisted of one normal fluent female (model) (47-year old) Kannada speaker and ten stutterers in the age range of 15-30 years. Material consisted of ten sentences of different intonation patterns depicting various emotions such as anger, sarcasm, surprise, command, question statement. The utterances of the model and the imitations of the intonation patterns by stutterers were recorded both before and after therapy.

Acoustic and perceptual analysis was done on the recorded data. The sentences were digitized at 16,000 Hz sampling frequency using a 12 bit A/D converter. Using the Analysis < F_0 EDIT programmes of the SSL software (Voice and Speech Systems, Bangalore), parameters related to F_0 (Mean F_0 , Absolute Maximum F_0 , Absolute Minimum F_0 , Absolute range F_0, Effective Maximum F_0 , Effective Minimum F_0 , Effective range F_0 , Psigma F_0), intensity (mean, maximum, minimum,

range), voicing (% voiced and unvoiced) and using the 'DISPLAY' programme, sentence durations were measured. The data was tabulated and T-test was done to test for the presence of any significant difference between the model, pre-therapy and the post-therapy utterances.

The same sentences of the model and stutterers were juxtaposed and audio-recorded which was given for perceptual evaluation to three judges. They were to indicate 'S' (same intonation pattern) or D (different intonation pattern) on listening to the intonations of the normal and the stutterer. The percent same and difference were calculated and interjudge correlation was found out.

The results indicated the following:

(a) The pre- and post-therapy speech of the ten stutterers who underwent prolongation therapy differed from that of the normals.

(b) A reduced prosodic variation (reduced F_0 range) was seen in the stutterer's speech.

(c) The stutterer's speech also revealed longer sentence duration due to reduced temporal coordination when compared to normals.

(d) There was no significant change in the prosodic aspect of the post-therapy speech as expected.

(e) The intonation patterns of pre-therapy and post-therapy speech were not perceived as significantly different from that of the model.

Thus, from this study, one can conclude that though the stutterer's speech was monotonous when compared to the normals, no evidence is there to indicate that monotony could have occurred due to prolongation therapy. It is suggested that other aspects of prosody such as stress and rhythm could be studied in the post-therapy speech of stutterers.

BIBLIOGRAPHY

Adams, M.R. (1955). A comparison of certain sound wave characteristics of stutterers and non-stutterers. In W. Johnson & R.Leutenegger (eds.) Stuttering in children and Adults, Minneapolis: Univ. of Minnesota Press.

Adams, M.R. (1981). The speech production abilities in stutterers: Recent, ongoing and future research. Journal of Fluency Disorders, 6, 311-326.

Andrews, G., and Harris, M. (1964) The Syndrome of stuttering. In Dalton, P. and Hardcastle, W.J. (Eds.), Disorders of Fluency and their effects on communication: Edward Arnold Inc. London.

Bergmann, G. (1984). Cited in Bergmann, G. (1986) "Studies in stuttering as a Prosodic disturbance", Journal of speech and Hearing Research, 29,290-300.

Bergmann, G. (1986) Studies in stuttering as a Prosodic disturbance Journal of Speech & Hearing Research, 29,290 - 300.

Bloodstein, O., A Handbook of stuttering ,Chicago III, National Easter Seal Society for crippled children and Adults (1975)

Boehmler, R. (1958) cited in Conture, E.G., (1990) "Childhood stuttering: What is it and who does it ?" ASHA, 18, 2-13.

Boehmler, R., (1970). cited in Ingham, R.J., and Packman, AC (1978) "Perceptual Assessment of normalcy of speech following stuttering therapy", Journal of speech & Hearing Research, 21, 63-73.

Brown, S.F. (1937) cited in bergmann, G, (1986) "Studies in stuttering as a prosodic disturbance", Journal of Speech & Hearing Research, 29, 290-300.

Brown, S.F., (1938) cited in Bergmann, G , (1986). "Studies in Stuttering as a Prosodic disturbance", Journal of Speech & Hearing Research, 29, 290-300.

Brown, S.F., (1945) cited in Bergmann, G. (1986). "Studies in stuttering as a Prosodic disturbance", Journal of Speech and hearing Research, 29, 290-300.

Brungelson, B.A. (1932) cited in Healey, E C , (1982) "SFF characteristics of stutterers and Non stutterers, "Journal of communication Disorders, 15, 21-29.

Dalton, P., and Hardcastle, W.J. (Eds.) Disorders of Fluency and their effect on communication , Edward Arnold Inc: London (1977).

Fernau - Horn, H. (1973) cited in Bergmann, G. (1986) "Studies in Stuttering as a Prosodic disturbance", Journal of speech & Hearing Research 29, 290-30.

Franken, M.C., Boves, L., Peters, H.F.M., and Webster, R.L. (1991) Prosodic Features in the speech of Post - therapy stutterers compared with the speech of Non-stutterers. In Peters, H.F.M., Hulstijn, W., and Starkweathers (Eds), Speech Motor Control and stuttering: Elselvier Science Publishers.

Goldiamond, I., (1965) cited in Ingham, R.J., and Packman, AC. (1978)" Perceptual assessment of Normalcy of speech following stuttering therapy", Journal of speech and Hearing Research, 21,63-73.

Heaiey, E.C. (1982) SFF characteristics of stutterers and Non stutterers, Journal of communication disorders, 15, 21-29.

Healey, E.C, and Gutkin, B. (1984) Analysis of Stutterers' Voice onset time and F_o contours during fluency. Journal of speech & Hearing Research, 27, 219-225.

Hejna, R.F., (1972). The relationship between Accent or Stress and Stuttering during spontaneous speech (Abstr.) ASHA, 14, 479.

Horii, P., (1975) Cited in Schmitt, L.S., and Cooper, E.B., (1978) "Fundamental Frequencies in Oral reading behaviour of Stuttering and Non-stuttering male children, "Journal of communication disorders, 11, 17-25.

Hubbard, *C.P.,* and Prins, D. (1994). Word familiarity, Syllabic stress pattern and stuttering, Journal of Speech & Hearing Research, 37, 564 - 571.

Ingham, R.J., and Andrews, G , (1973) Cited in Inham, R.J., and Packman, A.C. (1978). "Perceptual Assessment of normalcy of speech following stuttering therapy, " Journal of Speech & hearing Research, 21, 63-73.

Ingham, R.J., Andrews, G., and Winkler, R. (1972) cited in Ingham, R.J., and Packman, A.C. (1978). "Perceptual Assessment of normalcy of speech following stuttering therapy. "Journal of Speech & Hearing Research, 21, 63-73.

Ingham, R.J., and Packman, A.C. (1978) Perceptual Assessment of normalcy of speech following stuttering therapy. Journal of speech & Hearing Research, 21, 63-73.

Lechner, B.K. (1979) cited in Heaiey, E.C. (1982) "SFF characteristics of stutterers and non-stutterers", Journal of communication disorders, 15,21-27.

Luschinger, R., and Dubois, C. (1963) cited in Heaiey, E. C. (1982) "SFF characteristics of Stutterers and Non-stutterers. Journal of communication Disorders, 15, 21-27.

Perkins, W.H. (1973a) cited in Ingham, R.J., and Packman, A.C. (1978) "Perceptual Assessment of normalcy of speech following stuttering therapy", Journal of speech & Hearing Research, 21, 63-73.

Prins, D., Hubbond, C.P., & Krause, M. (1991) cited in Hubbard, C.P., and Prins, D. (1994)" Word familiarity, Syllabic stress pattern and Stuttering", Journal of speech & Hearing, Research, 37, 564-571.

Ramig, P.R., and Adams, MR. 91981) Vocal changes in Stutterers and Non-stutterers during high-pitched and low-pitched speech Journal of Fluency Disorders, 6, 311-326.

Schiavetti, N. (1975) Cited in Conture, E.G. (1990) "Childhood stuttering: What is it and who does it? ASHA, 18, 2-13.

Schimtt, L.S., and Cooper, E.B., (1978) Fundamental Frequencies in the Oral reading behaviour of Stuttering and Non-stuttering male children, Journal of communication Disorders, 11,17-25.

Scripture, C.W., (1925) Cited in Bergmann, G. (1986) "Studies in Stuttering as a Prosodic disturbance, "Journal of Speech & Hearing Research, 29, 290-300.

Sheehan (1975) Stuttering behaviour: A phonetic analysis, Journal of communication Disorders, 7, 193-212.

Travis, L.E. (1927) cited in Healey, E.C. (1982) "SFF Characteristics of stutterers and Non stutterers ", Journal of communication Disorders, 15, 21-27.

Van Riper, C. (Eds.) The Nature of stuttering; Englewood Cliffs, N.J: Prentice Hall (1971).

Van Riper.C, (Eds). The Treatment of stuttering, Englewood Cliffs, N.J: Prentice Hall (1973).

Van Riper, C. (Eds.)., The Nature of Stuttering (2nd Ed.) Englewood Cliffs, N.J: Prentice Hall (1982).

Von Essen (1939) cited in bergmann, G., (1986) "Studies in Stuttering, as a Prosodic disturbance", Journal of Speech & Hearing Research, 29, 290-300.

Webster, R.L. (1974). Cited in Bergmann, G. 91986) "Studies in stuttering as a Prosodic disturbance, Journal of speech & Hearing Research, 29, 290-300.

WHO (1977) cited in Ludlow, C.L. (1990) "Research Procedures for measuring stuttering severity", ASHA, 18.26-31.

Williams, D., & Kent, L. (1958) cited in Conture, E.G. (1990) "Childhood stuttering: What is it and who does it: ? "ASHA, 18, 2 - 13.

Wingate, M. (1964) A standard definition of stuttering, Journal of speech & Hearing Disorders, 29, 484-489.

Wingate, M. (1980) cited in Hubbard, C.P., and Prins, D. (1994) "Word familiarity, syllabic stress pattern and stuttering, "Journal of speech & Hearing Research, 37, 564-571.

Wingate, M. (1984). Definition is the problem, Journal of Speech & Hearing Disorders, 49, 429-431.

Wingate, ME. (Eds.) Stuttering Theory and Treatment, NY, Irvington, New York, 1976

Zebrowski, P. and Conture, E.G. (1989) cited in Conture E.G. (1990) "Childhood stuttering: What is it and who does it[9], ASHA, 18,2-13.