TEMPORAL–ACOUSTIC MEASURES IN THE SPEECH OF STUTTERERS AND NORMALLY NONFLUENT CHILDREN

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MYSORE 570 006

MAY 1989

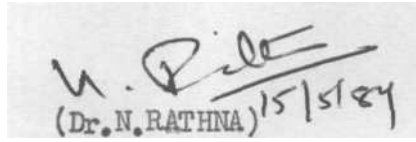
"Dedicated to

My beloved

Parents"

C E R T I F I C A T E

This is to certify that the dissertation entitled "TEMPORAL - ACOUSTIC MEASURES IN THE SPEECH OF STUTTERERS AND NORMALLY NON-FLUENT CHILDREN" is the bonofide work in part fulfilment for the degree of Master of Science (Speech & Hearing), of the student with Register No.M.8705.



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C_E_R_T_I_F_I_C_A_T_E

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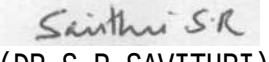

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D E C L A R A T I O N

This dissertation is the result of my own study-undertaken under the guidance of Dr.S.R.Savithri, Lecturer in Speech Science, All India Institute of Speech & Hearing, Mysore, and has not been submitted earlier at any University for any other Diploma or Degree.

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A_C_K_N_O_W_L_E_D_G_E_M_E_N_T

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C_O_N_T_E_N_T_S

L I S T O F T A B L E S

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C H A P T E R - I

INTRODUCTION

"Fluency is the ability to write or speak easily, smoothly and expressively". (Wingate 1984)" "The word'fluency' cannotes facility in speech and language performance. People who are fluent are so skilled in the performance of speech and language behaviours that they do not need to expend much thought or energy to it. Sounds, words and sentences fall easily from mouths without hesitation and are strung together one after the other rapidly and with few pauses. It is normal to be fluent, this is not true of other sequential behaviours "(Starkweather ' The words 'fluent' and fluency are reserved almost exclusively to refer to speech and to writing as a graphic record of speech.

Perkins (1977) refers to fluency as "A barometer for the entire speech system of performance of the other dimensions of speech. In order to start speech fluently i.e., prompty, easily and in a co-ordinated manner, an individual must meet several requirements. Specifically, he needs to quickly and with an economy of muscular effort, adjust respiratory, phonatory and articulatory activity, so as to (a) start air - flow upward and out of the lungs (b) create a source of structural resistance at the glothis to this upward moving column of air (c) bringing the pressure of the subglottic air to level efficiently in excess of supraglottic air pressure to blow the vocal cords apart and send them into periodic vibration for voicing and

(d) set into motion and then complete the articulatory gesture that is first integral part of his intended Meaningful utterance. A fifth requirement of critical importance involved is the integration of the preceding four adjustments so that they overlap in time and occur in what appears to be virtually simultaneous manner. When a speaker does not co-ordinate these events up and down the vocal tract, a disfluency of one type or another usually results. For Example: If phonation proceeds articulation, an interjection is likely to be heard. If on the other hand, articulatory posturing occurs before the initiation of airflow or voicing, a silent prolongation is observed" (Adams; 1982)

Hedge (1978) and Adams (1982) suggested that fluency can be described in terms of features that contrast with disfluency. But such a procedure is an inversion of the way in which the meaning of words are established.

There are many types of fluency and many ways of looking at it. Fillmore (1979) has described three types of fluency which correspond to three of the four major components of language - syntax, semantics and pragmantics. "Fillmore (3979) believed that speakers who are syntactically fluent have the ability to encode highly complex sentences representing a wide variety of complex content form relations. Semantically fluent speakershave large vocabularies to which they have full and ready access. Pragmatically fluent speakers always know what

to say under a wide variety of social circumstances. The fourth major component of langnage, phonology, was not described by Fillmore, but his list earn be augmented to include phonologically fluent speakers, who would have the ability to pronounce correctly and acurately long strings of syllables in unfamiliar combinations" (Starkwether;1987)

A number of factors affect the fluency of speech; viz., physiological, psychological, emotional and linguistic; The size and mass of the structures is only one among this. Specifically, the massiveness of the parts of the vocal tracts will influence the speed with which the movements can be initiated, and once begins, the ease with which they can be stopped or redirected. There are many compensatory forces however. As speech is acquired, the timing and velocity of movements develops within the constrains of the mechanism as it exists at any stage of growth. Some Central Nervous Systems are probably adept, relative to others, in making adjustments to changes in the mechanism introduced by growth. (Starkweather; 1987)

When any of these factors are affected, a breakdown in fluency (dysfluency) results because of which speech will be affected. The terms disfluency and non-fluency suggest that speech is not fluent. Discontinuities would always slow rate and would of course require some effort, but some discontinuities would slow rate more than others or be mere efforful than others and this distinction is clinically very important. It seems both accurate and useful to keep the dimensions of fluency seperated in the words that are used to describe it. Stuttering

and cluttering are two disorders of fluency.

Stuttering is a disturbance of rhythm and fluency of speech by an intermittent blocking, a convulsive repetition or prolongation of sounds, syllables, words, phrases or posture of speech organs. (Travis; 1971)

It is well docomunted that children between the ages of 3 - 5 years experience periods of dyafluency which vary, often depending upon the emotional and linguistic load present in the communicative interaction. This condition is referred to as Normal Nonfluency. However only a small percentage of these children who are dysfluent actually become stutterers.

Froeschels (1969) suggest that normal dysfluencies have a place on the same continuum as stuttering and that the latter is simply a more severe and more frequent manifestation of the former. Bloodstein (1969) hypothesized that the difference between normal nonfluency and stuttering was one of degree, rather than a distinct entity.

According to Johnson (1967) "There is evidently no clear sharp line between the speech of stutters and that of non-stutterers. Certainly, not with resepct to fluency. It seems to be the case that speakers are distributed along the various dimensions of speech behaviour, including fluency, with the great majority found to be

somewhere between the extrenwes" .

Clinically it is very important to distinguish the condition stuttering from Normal nonfluency for the management of the patient. Various characteristics of normal nonfluency have been reported by several experimentors which could differentiate it from stuttering; Van Riper (1962) syllable repetition, prolongation, awareness, reaction to stress; Voelker (1944), syllable and phrase repetition; Silverman (1972) part-word repetitions; England (1976), frequency of disfluency; Bjerkans (1980), word fragmentations;

Stromsta (1965) On the basis of spectrographic analysis of the speech of normally confluent children reported that these children who did not show transition on the spectograms tended to become stutterers.

Inspite of the extensive research on stuttering and normal nonfluency, the characteristics of normal nonfluency are still not understood and the characteristics of normal nonfluency that effectively differentiate it from stuttering are not well understood. In this context, there is a need to study the various characters of normal nonfluency and stuttering to effectively implement it in clinical situation for differential diagnosis and therapy.

The present study attempts at extracting the temporal parameters in normal nonfluency and stuttering speech and examining the effectiveness of these features in differentiating between normal nonfluency and stutteri-ng

The information of this study would be useful in identifying the characters of nomal nonfluancy and possibly to differentially diagnese normal nonfluency from stuttering. Clinically it would facilitate the detection of nornally nonfluent and stuttering children and to further rehabilitate them.

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CHAPTER - II

REVIEW OF LITERATURE

The speech; - both fluent and nonfluent of stutterers has been subjected to acoustic analysis since a long time to explore the articulatory and laryngeal behavior of stutterers and to probe in to the causes of stuttering. Also, it is compared with those of normals and normally nonfluent speech to different iate and thus to effectively rehabilitate. This review presents the/acoustic characteristic of the/Pered speech of strutterers and normally- nonfluent/ In brief, acoustic /children analysis comprises of the various spectral and temporal parameters of speech. However, this review is restricted to perceptual and temporal speech parameters. It is organized under the following subheadings.

l.Temporal characteristics of the speeoh of

1.1 Stutterers

1.2 Stutterers Vs Normals

2. Characteristics of the speech of normally nonfluent children.

5. Differences in the speech characteristics of normally fluent/ normally nonfluent/ and stuttering children/adults.

1.1 Temporal characteristics of the speech of stutterers:

Agnello (1971) analyzed spectograms of the stutterers speech and concluded that the acoustic and pause characteristics of the stutterers dysfluencias differed from their normal speech disfluencies. Furthermore, stuttering nonfluancies did not show the normal downward shift of the second formant associated with normal articulatory positioning.

Van Riper (1971) cites research which employs both speotographic and cineflourographic analysis & concludes that the dysfluencies of stutters V/s nonstutterers were different along several dimensions.

Adams and Reis (1971) investigated the difference in the frequency of dysfluencieas of voiced and unvoiced phonemes in stutterers. They hypothesized that if the larynx was an important site in the breakdown of fluency, then conditions requiring increased laryngeal adjustment would create an increase in the frequency of stuttering. Data of this study suggested that the termination or initiation of phonation is directly related to the frequency of stuttering.

Mams and Reis (1971) and Manning and Coufal (1976) reported that increased stuttering is more likely to occur during voiceless to voiced phonation transitions than voiced to voiced transitions.

Webster (1974) suggested that stutterers use articulatory patterns that are too forceful and co-articulatory movements that are too rapid.

Klich and May (1982) in studying formant frequences and duration and rate of formant frequencies transition of /i/,/æ/ and /u/, found that adult stutterers did not vary these articulatory details in different conditions. When compared to data reported on non-stutterers the authors concluded that stutterers vowel productior was more spatially and temporally restricted.

Stuttered and non-stuttered phonemes of 20 adult males were analyzed for distinctive feature patterns using the Chomsky - Halle system by idells (1985). The features (+ Consonantal) (- voice), (+ Continuant) and (- Strident) occurred significantly more often in stuttering than in non-stuttering instances. Results suggest that in adults, stuttering is most likely to occur when the primary sites of tension and disco-ordination are lingual and laryngeal and when the speaker must shift from (- voice) to |+ voice|

Ramesh (1985) spectrographically analyzed the speech of stutterer's under delayed auditory feedback. He found that there was no difference in Voice onset time between stutterers and non-stutterers.

1.2. Temporal characteristics of the speech of stutterers as compared to normals:

Researchers have compared various aspects of stuttering and normally fluent speaker's fluent speech and found that stutterer's fluency is characterized by longer vowel durations (Disimoni, 1974) vowel productions which are more temporally and spatially "restricted" (Klich and May, 1982) and longer transitional subsegments vithin an intervocalic interval (Starkweather and Meyers, 1979)

Agnello (1974) employed spectographic analysis from which he believed indirect physiological implications could be made. Voice onset time (VOT) and voice termination time (VTT) in 25 adult stutterers were compared with the same values obtained from an equal number of non-stutterers. All subjects were required to produce the same test vowel /ah/, begining and ending with voiced and voiceless plosive cognates i.e., /pa, ba, ap, ab/. Stutterers employed significantly longer transition times for both voice onset and voice termination than did non-stutterers. Stutterers were "slower in initiating the voice during the opening phase of consonant release (VOT) or slower in approaching the closure (VTT) Phase".

Disimoni (1974) studied the timing relationships in the speech of stutterers. He found that the phoneme durations of stutterers were greater than those found in non-stutterers. Differences exist in phoneme duration and in certain aspects of the timing of fluent sequences of phonemes in stutterers. Stutterers also show greater variability than non-stutterers in durational control.

Disimoni (1974) found that the consonant and vowel durations of adult stutterers ware more variable than were the same measures obtained for a group of non-stutterers.

Hirschman, Starkweather and Tannenbaum (1976) compared laryngeal reaction time of stutterers to normals. Using 11 stutterers and 11 normal controls, the experimenters presented a visual stimulus consisting of a variety of syllables and measured the latency of vocalization of frequently produced utterances. Results showed that stutterers had a significantly longer latency of vocalization than did the control group. It once again suggests difficulty with the phonatory adjustments necessary to initiate voicing.

Cooper and Allen (1977) investigated the speech timing control

accuracy of stutterers and non-stutterers during both speech and non-speech activities. In general, they found that their group of stutterers tended to be less accurate in their timing abilities. The data also showed a vide range of timing abilities among all the subjects with some stutterers performances equal to those of certain non- stutterers.

Several researchers have experimented on the VOT of normals and stutterers which are in table 1. The experimenters) are cited in column 1. Column 2 describes the methodology for measuring VOT. Column S provides information on the subjects tested, and column 4 sets out the results of between group comparisons.

(1)	(2)	(3)	(4)
Agnello and Wingate (1972)	Pressure - sensor and voice - recorder; CV utterances	Matched groups of 12 adults stutterers and 12 normals	Stutterers VOT were longer
Agnello (1977)		Metched groups of stutterers and normals	VCR and VTT wer longer in stutt ers.
Wendell (1975)	Spectrographic analysis of CVs	Matched groups of 12 child stutterers and 12 normals	Stutterers VOTs were longer.
Hillman (1977)	Spectrographic analysis	Stutterers Vs. non- stutterers	Greater lag in voicing of fluent speech of stutterers.

(1)	(2)	(3)	(4)
Hilman and Gilbert (1977)	Spectrographlc analysis of CV's taken from oral reading.	Matched groups of 12 adult stutterers and 10 normals.	Stutterers VOT were longer (P 0.05)
Metz, Conture and Caruso (1979)	Spectrographic analysis of 18 different sound clusters in words	Five young adult stutterers and five normals	Stutterers VOT were longer or only 6 of the 18 clusters (P .05)
Zimmerman (1980)	X-ray motion picture and voice recorder, three CVC words	Six adult Stutterers and seven normals	Stutterers VOTs were longer.
Watson and Alfanso (1982)	Spectrographic analysis of three contiguous vowel * consonent + vowel + consonent sequences.	Eight adult stutterers, age and sex, matched with 8 normals.	No significant between group differences in VOT (P .05)

Table 1: VOT of normals and stutterers (in m.secs.)

(Cited from stuttering as laryngeal disorder by Adams and Sonture in the book Nature and Treatment of Stuttering by Curlee and Perkins)

Basu (1979) in his study compared the VOT's of stutterers for voiced and voiceless stop sounds of Kannada language in spontaneous reading and in syllables, in isolation with that of non-stutterers. The results of the study revealed that the stutterers showed a longer VOT for voiceless and voiced stop sounds both in reading and in isolation when compared to that of non-stutterers. There was a difference in VOT

between each voiceless stop sound and its voiced counterpart; i.e., there was always a voicing lag for the voiceless stops sounds and a voicing lead for voiced stop sounds. This was observed for both stutterers and non-stntterers in reading as a well as in isolation. The stop sound in isolation consistently displayed a longer VOT than in reading. There was a consistent increase in VOT with respect to the position of articulatory contrictian in case of non-stutterers. No consistent variation in VOT with respect to the position of articulatory contriction was observed for stutterers. However, there was a difference in VOT for various stop sounds.

High speed cineradiography was used by Zimmermann (1980) to describe the temporal organisation of perceptually fluent speech in stutterers and non-stutterers. Movements of the lower lip and jaw were analyzed in 3 consonant + vowel + consonant (CVC) syllables. Stutterers consistently showed (1) Longer transition times for downward movements of the articulators. (2) Longer times between movement onset and peak velocity in the CV gestures. (3) Longer steady state positions of the lip and jaw during the vowel portions of the syllable.

In 1980 (b) he studied the temporal and spatial relations of movements of the lower lip and jaw and found longer temporal inter-relationships of these movements for stuttering subjects as compared to normal speakers.

Prosek and Runyan (1982) spectrographically measured the duration of stressed vowels extracted from short segments of connected speech. The successfully treated stutterers used in this investigation spoke with more pauses and with longer average pause and vowel duration than did non-stutterers. Total durations of stressed vowels average 170.6 ms for stutterers and 144.1 ms for non-stotterers, vowel subsegments were not specifically measured.

Janssen, Wieneke and Vaane (1983) designed a study to investigate the differences between stutterers snd normal speakers in pbonatory and articulatory timing during the initiation of fluent utterances of monosyllabic words. ELectromyographic recordings of four articulatory muscle and recordings of glottal vibrations were made of repetitive utterances of a series of monosyllabic words by 15 stutterers and 17 non-stutterers. These data were analyzed in terms of average interval times between

voice onset and onset of BUG activity and between onset of BUG activity.in each articulator and in terms of the intrasubject variability af these durational measures. Results showed that there ware no significant differences between stutterers and non-stuttarers in average interval times and that stutterers, in general, were significantly more variable in their speech onset timing.

Pindozola (1987) gtudlad durational characteristics of the fluent speech of stutterers and non-stutterers. He found that the steady state duration of vowel was significantly different between stutterers and non-stutterers. Stutterers showed greater variability in the duration of transition than did non-stutterers.

Wingate (1984) focused on the antecedents and sequelae of filled pauses, revealed substantial differences in pattern of pause occurrence between stuttered and normal speech samples obtained from 20 matched subjects. The results showed the stuttered samples to have absolutely more filled pause than normal speech samples. This finding was consistent with evidence from many sources in the comparative stuttering research that show speech samples from stutterers to contain more disfluencies of all types than do samples of normal

speech.

Suchitra (1985) studied co-articulation in stuttering, She compared fluent utterances of stutterers and normal speakers. Results indicated that, though the rising and falling trend of the formant frequency transition was the same in fluent speech of stutterers ag it ia in the normal speakers? the extent of such transitions was different in the two groups of subjects. The Co-articulatory 'differences' found in the fluent utterances of stutterers indicated that the articulatory configurations required for the production of a phoneme in question were not fully achieved.

Watson and Alfonso (1987) conducted an experiment for comparision of laryngeal reaction time and voice onset time values between stutterer! and non stutterers. The experiment reported no significant group differences in laryngeal reaction time (LRT) and voice onset time (VOT) values. Rank-order correlations between the stutterers LRT and VOT values were also non-significant.

According to Johnson "There is evidently no clear and sharpline between the speech of stutterers and that of non-stutterers, certainly

not with respect to fluency. It seems to be the case that speakers are distributed along the various dimensions of speech behaviour including fluency with the great majority found to be somewhere between the extremes". {Johnson 1967)

2.Characteristics of the speech of normally nonfluent children:

Davis (1939) studied the dysfluencies of non-struttering children aged 24-60 months. She found that repetitions of syllables, words and phrases ware common in this group.

Wexler (1978) presented initiatory norms on the disfluency characteristics of 2, 4 and 6 years old boys. The most frequently occuring disfluency types at each level were revision, incomplete phrase and interjections, the least noted type was part-word repetitions for 2 and 4 years olds and disrhythmic phonations for 6 year olds. Patterns of disfluency appear to be similar at all age levels studied, except that the 2 year old pattern showed greater magnitudes in various disfluency types.

Bjerkan's (1980) suggested that "word fragmentation" was the most characteristic feature which distinguished the speech of stutterers from the speech of non-stutterers. He concluded this based on the results of his research which demonstrated that fragmentations were extremely rare in the speech of non-stuttering preschoolers, but occured significantly in the speech of children regarded as stutterers

Gregory (1986) found that pauses, revisions and interjections (non repetitious disfluencies) occur most frequently in the speech of

preschool children (Brownell; 1975; Dejoy, 1975, WexLer and Mysak, 1982), Single - syllable word repetition,mostly at the beginning of syntactic units, is fairly frequent in children's speech during 2nd and 3rd years when relational language is developing at a rapid pace (Blood-stein and Gantwerk 1967, Yairi 1981). Breaks in fluency at the word level (Sound and syllable repetitions and prolongations of sounds) are the least frequent (Brownell, 1975; Dejoy, 1975: Haynes & Hood, 1977; Bjerkan,1980 Wexler and Mysak, 1982). However, Johnson (1955) and Yairi (l98l) repor that 2 year olds may emit considerable part-word repetition. Yet, they report that part-word repetition decreases during the 3rd year. Non-stutterera average roughly one repetition per instance of one syllable word repetition or part-word repetion (I,I; Ma - Ha)whereas stuttering children average about two reiterations per occurrence ('I, I, I; Ma Ma Ma') (Yairi and Lewis, 1984.). "As we know, there is overlap between the two groups. Some non-stuttering children at times show as high as four or five repetitions per instance of disfluency. Perhaps the regularity (Even or Uneven stress) is a distinguishing feature, clinical evidence being that stuttering children show more unever rhytha and stress in their repetitions (Gregory & Hill, 1984)

Syntactic context appears to influence the occurrence of disfluency. Most studies of either non-stuttering or stuttering preschool children have revealed a greater than expected number of disfluencies on function words and pronouns at the beginning of syntactic units (Bloodstein and Gantwerk, 1967; Helmreich & Bloodstein, 1975, Silverman, 1975). Younger children probably respond to these syntactic units as the basic units of speech formulation and motor speech production. During the ages 4 to 8, there is a transition from this to more disfluency or stuttering on content words. Regarding sex differences, studies by Davis (1939), Oxtoby (1943), Yairi (1981) have shown that there is a higher frequency of part-word syllable repetition in boys; however, no differences have been statistically significant. Yairi (l981) reported a trend for boys te show more repetitions per instance of syllable repetition. Listener reaction studies (Boehmler, 1958; Giolas and Williams, 1958; Williams & Kent, 1958) in which observers judged disfluencies drawn from the speech samples of both non-stutterers and stutterers have shown that there is greater aggreement in classifying sound and syllable repetitions as stuttering. Revisions and interjections are judged infrequently as stuttered. Several studies (Voelker, 1944;

Johnson, 1959; Yairi & Lewis, 1984) have shown that speakers considered to be stutterers emit substantially greater amounts of sound and syllable repetitions and prolongations. In addition, adding together non-repetitious and repetitious types, stuttering children show a higher amount of total disfluency (Yairi & Lewis, 1984)

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3. Differences in the speech characterisitics of normally non-fluent and stuttering children/adults:

3.1. Perceptual characteristics:

There are several perceptual characteristics that differentiat Normal non-fluency and Stuttering. All these are summerized in table

Sl. No.	Characteristics	Stuttering	Normal non-fluency
1.	Speech under stress	Worse	Worse
2.	Speech in relaxed situation	Better	Better
5.	Calling attention to speech	Worse	-
4.	Speaking after interruption	Worse	-
5.	Short answers	Worse	-
6.	Foreign Language	Morse	-
7.	Hell known text	Better	-
8.	Unknown text	Worse	-
9.	Syllable repetition frequency/word frequency/100 words Tempo	> 2 >2 Faster than normal	< 2 < 2 Normal
10.	Prolongation	>/100 words	<1/l00 words
11.	Terminations	Sudden	Gradual
12.	Gaps	Present	Absent
13.	Inflections	Restricted monotone	Normal
14.	Under DAF	Reduction	Exaggerated
15.	Spontaneous recovery	Present	Present

Table 2: Characteristics of the speech of stuttering and normally non-fluent children:

Voelker (1944) compared the disfluencies of stutterers and non-stutterers of age 12 to 19 years. He found that average speaker had no syllable repetitions per 100 words and less than one word and one pharse repetition per 100 words. Furthermore, he indicated that the speech of the stuttering group was typified by syllable and word repetitions and prolongations.

England (1976) compared the speech of non-stuttering Kinder-garden children with the speech of preschoolers diagnosed as stutterer: Both groups demonstrated part-word repetition. However, stutterers showed a high frequency of all dysfluency types, a greater number of repetitive syllables within a repetition and a higher percentage of sound and syllable repetitions.

5.2. Temporal Characteristics:

Stromsta (1965) demonstrated that the spectrograms of stuttered speech revealed a lack of usual falling or rising transi-tions shown in spectrograms of normal speech. The juncture formants were not present or were different.

Stromsta's (1965) research showed that those children whose spectrograms of disfluencies showed anamolies in co-articulation failed to "outgrow" their stuttering and those children whose spectrograms showed normal juncture formants had become fluent in the ten year span since the original recordings were made.

Healey & Adams (1381) explored the speech timing skills of normally fluent and stuttering children and adults, producing two sentences, ten consecutive times at basal and modified speaking rates. Spectrographic displays of subjects utterances in both conditions were made in order to obtain consonant, vowel, pause, and utterance duration measures. Results showed that the two groups of children produced speech durational values similar to those of the two adult groups and there were no consistency between and within group differences in the basal and modified rate conditions.

Healey et.al(1381) measured transition and steady state subsegmental durations extracted from single sentence produced by child. Stutterers and non-stutterers (age 7 - 12). Stutterers were significantly slower only in completing the transition from frication onset to peak amplitude during the /a/ Phonene; all other measures

were not significant.

Zebrowski etal (1985) analysed transition rates and durations along with durations of stop gap, frication, aspiration and voice onsets in 11 incipient stutterers. No significant differences were found betwee the child stutterers and matched non-stutterers for any of the temporal measures.

Cudahy, Zebrowski & Conture (1985) conducted a study to provide a preliminary description and comparism of the temporal parameters of speech production of young stutterers and normally fluent peers as represented within the acoustic waveform (for Ex: frication and aspiration durations) for word initial /p/ and /b/. Subjects were 11 young stutterers (mean age = 4 years 5 months) and like number of sex and age matched (plus or minus 4 months) normally fluent youngsters (mean age = 4 year 8 months). Measured acoustic variables consisted of vowel - consonant transition duration (msec) and rate (Hz/msec), stop -gap, frication, and aspiration duration, VCT, oonsonant - vowel transition duration and rate and vowel duration. Results indicated

no significant differences between young stutterers and their normally fluent peers for any of the temporal measures for either /b/ or /p/, although differences in frication duration approached but did not reach significance. Correlational analysis did indicate differences between the two talker groups in that the normally fluent youngsters exhibited an inverse relation between stop-gap and aspiration durations while the young stutterers demonstrated a lack of any clear relation between these two temporal variables. Findings seem to suggest that young stutterers exhibit some difficulties effecting the relatively smooth co-ordinated "compensatory" relations between laryngeal and supralaryngeal behaviours which would allow the system to remain within the "time limits" necessary for optimally smooth, ongoing, fluent speech production.

Concisely, stutterers do show variations in several of the temporal measures like phoneme duration, VOT, transition duration etc., The review of literature indicates that an excellent way to study the fluency of young stutterers is through acoustic analysis. The acoustic signal contains a variety of salient

temporal events that can be measured across a fairly wide range of productions (for Ex: from an isolated vowel to a phrase or sentence). Further, methods of acoustic analysis of speech do not required sensing devices inserted under the skin or into a bodily orifice (non-invasive) and do not interfere with the movements or gestures necessary for speech production.

Also, it has been shown (Elich & May, 1982) that temporal measures made from sound spectrograms of the acoustic speech signal can provide accurate, objective (albeit indirect) evidence relative to supraglottal and laryngeal behaviours. For example certain acoustic measurements provide very close estimates of the time taken by the supraglottal articulators to move from one speech sound to another (transition duration) or the time period from oral release of a consonant to the beginning of vocal fold vibration for the subsequent vowel (VOT). These, as well as similar measures can assist in discerning similarities and differences between the temporal parameters of the fluent speech of young stutterers and those of normally fluent children. In this context, the present study aims at spectrographically evaluating the temporal acoustic para-

meters of stuttering and normally non-fluent children.

C H A P T E R - III

M E T H O D O L O G Y

Material: A list of words taken from Kannada articulation test (Babu etal, 1972) and from articulation drill book (Purushothama & Savithri, 1388) were picturised and was used for the elioitation task. The words were selected so that it included all the consonants in Kannada in initial and medial positions. For spontaneous narration, a picture story from Upper Kinder Garten book was used. It consisted of eight pictures in succession depicting a story (Appendix)

Subjects: Subjects were two children with stuttering and two normally non-fluent children who were diagnosed by the speech pathologist. The age range of these children were 6 to 8 years. Their mother tongue was Tamil and they all resided in Karnataka and spoke kannada. There was no history of delayed speech and language and they were intellectually normal and had no hearing problem.

The speech characteristics of all the subjects are in table 3.

STUTTERING		NORMAL NON-FLUENCY	
S1 6 years Male	S2 7 years Female	S1 6 years Male	S2 6 years Male
Prolongations	Blocks	Blocks	Prolongations
Repetitions	Repetitions	Repetitions	Repetitions of words
Rate of speech - high	Articulatory fixations	Hesitations	Normal rate of speech
Blocks - Moderate	Rate of speech- normal	Rate of speec normal	Not aware of the problem
Severity Moderate	Severity - Mild to Moderate	Not aware of the problem	-
Aware of the problem	Aware of the problem	-	-

Table 3: Speech characteristics of the subjects.

Method: The subject was seated comfortably in a sound treated room. The microphone (Ahuja Unidynamic) was placed at a distance of 10 cms from his mouth. For the elicitation task, the subject was visually presented with a picture card and was instructed to name the picture. A trial was given for the same before the actual recording. For the narration task the pictures comprising the story were visually presented to the child and he/she was instructed to observe pictures carefully and to narrate the story. All these samples were recorded on a high fidelity magnetic tape using the internal tape recorder of the Sound Spectograph VII 700.

Analysis: Analysis of the speech samples was done by obtaining vide band bar type spectograms. Temporal measures analysed were as follows:

1. Vowel duration
2. Consonant duration (for consonants other than stops)
3. Closure duration
4. Burst duration
5. Voice onset time (VOT)
6. Transition duration of first formant
7. Transition duration of second formant
3. Speed of transition of first formant
9. Speed of transition of second formant

Measurement: The temporal parameters measured who as follows:

1. Vowel duration: Vowel duration were measured as the time between the point of onset and cessation of glottal vibration and of resonance areas.

2.Consonant duration: The duration of voiced/voiceless consonant was measured as the time between the offset of resonance for the preceding vowel and the onset of resonance for the following vowel, in the medial position. The initial fricative duration was measured as the time between the onset of frication and the onset of resonance

for the following vowel. The duration of the medial fricative was taken as the time between the offset and onset of resonance for the preceding and following vowel respectively.

3.Closure duration: This was measured as the time between the offset of the resonance for the preceding vowel and the burst for the stops in the medial position. For the voiced stops in initial position it was time between the onset of glottal vibration (Voice bar) and burst.

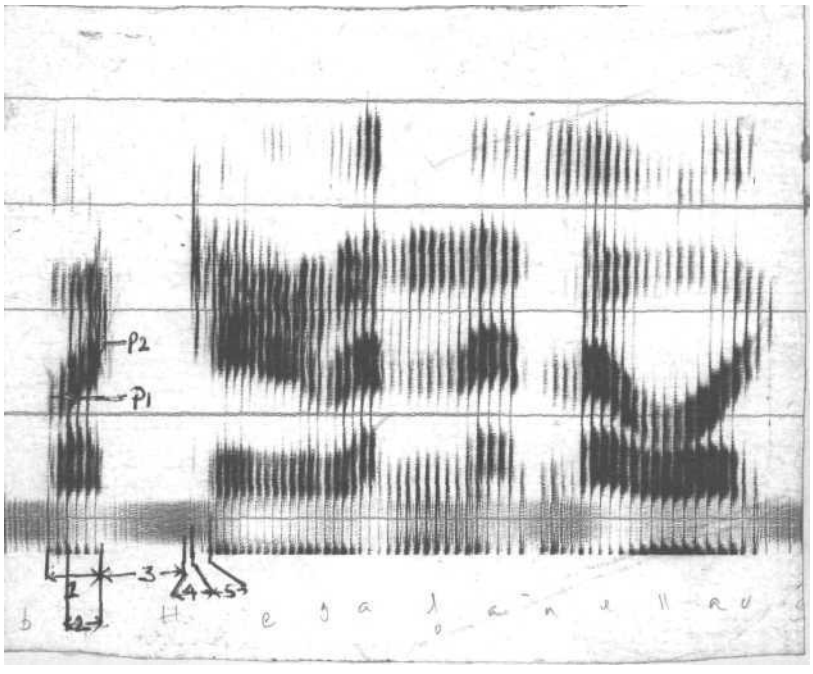
4.Burst duration: This was measured as the time for the spike/burst.

5.Voice onset time (VOT): VOT was measured as the tine between the articulatory release as evidenced by the burst and the onset of glottal activity for the following vowel as indicated by the voice bars on the spectograms.

6.Transition duration(Fl, F2): Transition duration (F1, F2) was measured as the time between the onset of transition of F1/F2 and the termination of the transition of the vowel/consonant.

7.Speed of transition (Fl, F2): The frequencies at the onset and termination of the transitions of Fl & F2 were measured. The difference between these divided by the transition durations for Fl & F2 was

considered as the speed of transition of F1 & F2 respectively. All these are illustrated in spectrogram 1.



1.Vowel duration

2.Transition duration

3.Closure duration

4.Burst duration

5.V0T

6.P1 = P2 = Speed of transition / Transition duration

Spectrogram 1: Depicting the different temporal parameters.

All these data were tabulated and appropriate statistical analysis was performed.

- x-

CHAPTER- IV

R E S U L T S A N D D I S C U S S I O N

Tvo normally non-fluent children and two stuttering children vere the subjects for the present study and nine temporal parameters vere spectrographically analyzed and 'T' tests vas applied to the tabulated data. None of the subjects shoved stuttering on the picture naming task. However they exhibited stuttering in the narration task. The results are discussed under the following headings.

1. Duration of vowals, dipthong and semivov3ls.
2. Closure duration.
3. Burst duration.
4. Voice onset time(VOT).
5. Transition duration of Fl.
6. Transition duration of F2.
7. Speed of Transition Fl.
8. Speed of Transition F2.
9. Duration of fricatives and nasals.
10. Other Characteristics.

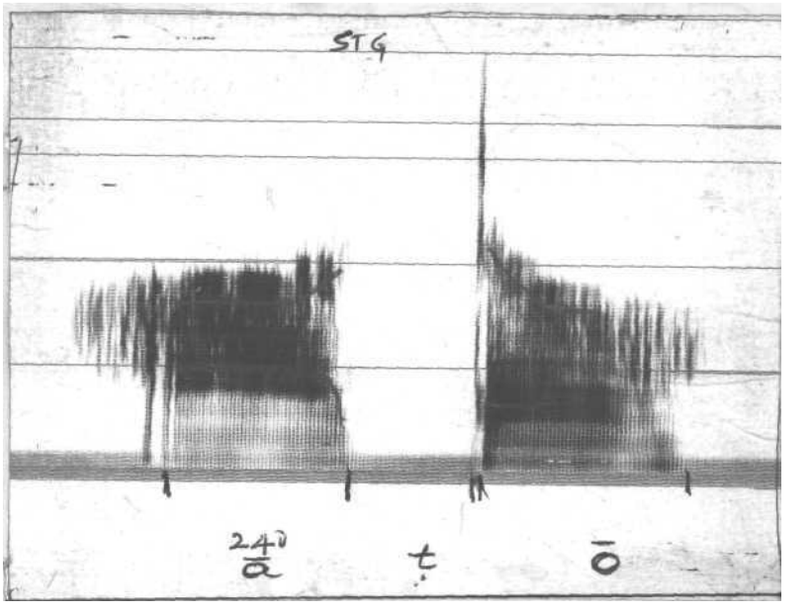
1. Duration of Vowels, dipthongs and Semivowels:

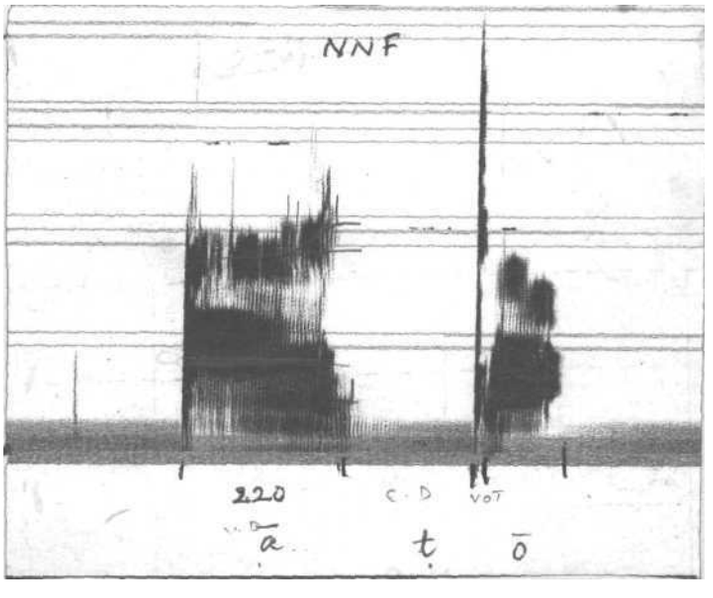
As only one dipthongs and two semivowels were used they were included under this category, [Hence forth will be referred to as vowel duration.]

The mean vowel duration was 157 & 120 m.secs. for stutterers and normally non-fluent speakers respectively. On 'T' test it was found that vowel duration differed significantly between stutterers and normally non-fluent children. Vowel duration among stutterers was found to be 37 m.secs. more than that of normally non-fluent children. The values are depicted in Table- 4.1. [Spectrogram. 2]

	Mean	S.E.	Difference	Probability level
Stuttering	157	9.12	37	0.0095
Normally non-fluency.	120	7.21		

Table- 4.1: Vowel duration of stutterers and normally non-fluent children.(in m.secs.)





Spectogram 2. Depicting the vowel duration in stuttering (STG) and Normally non-fluent (NNF) children in the word /at o/(in m.secs.)

The results of this study agree with those of Disimoni (1974) and Healey and Adams (1981) and are not in consonance with those of Zebrowski & Conture (1985).

Vowel is produced by the approximation of the articulators with the place of articulation and during ita production the oral cavity is almost open. Hence, the term vowel duration implies that the articulators is held in a position for the production of the vowel. The results indicate that in stutterers, vowel duration is longer than in Normally non-fluent children. Physiologically this implies that the articulator is held in the position for longer time than necessary. This might be because of longer duration of neural impulses for articulators.

This supports the theory of stuttering as a timing disorder; (Mackay & Mc Donald 1985) where in, the longer phoneme durations are explained on the basis of longer impulses. Also, the difference found in the present study might reflect compenstory behaviours which have been learned by stutterers.

Zimmerman (1980) on the basis of the results opines that in stutterers the events required for the production of the utterances

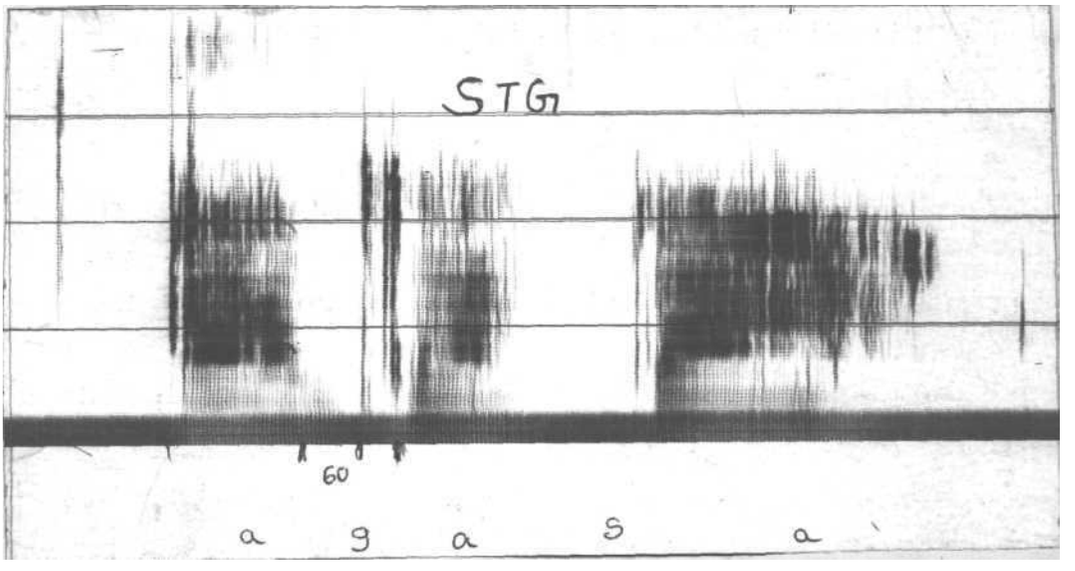
spread over a longer period of time. Though the differences were sometimes small relative to the variability, the consistency of the effect across utterances and parameters was apparent. These differences may reflect important physiological parameters for further investigation.

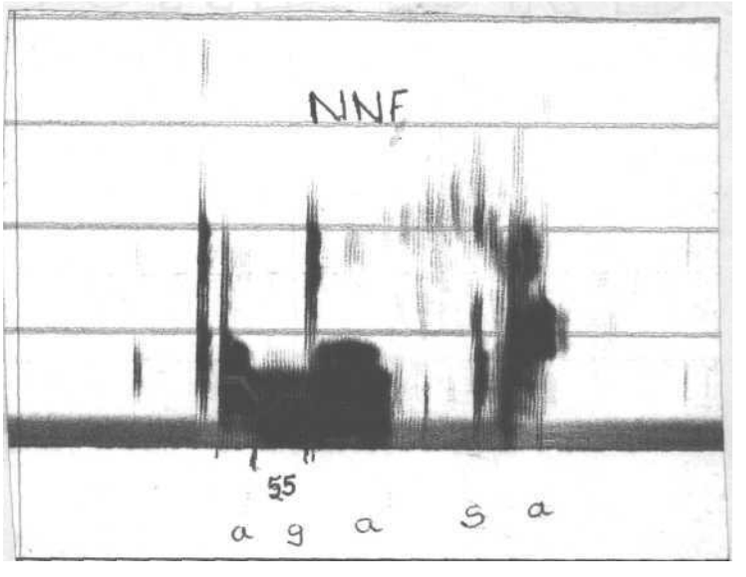
2. Closure duration:

The mean closure duration for stuttering group was 80.5 m.secs. and for that of Normally non-fluent group, it was 70.8 m.secs. Though the closure duration in stutterers speech was longer, it was not significant as found on T - test. The values are in Table.4. 2 (Spectogram -5)

	Mean	S.E.	Difference	Probability level
Stuttering	80.5	9.55	9.7	0.0781
Normal non-fluency	70.8	%.87		

Table - 4.2: Closure duration (in m.secs.) among stuttering and Normally non-fluent children.





Spectrogram -3: Showing the Closure duration of /g/ in the word /agasa/(in m.secs.).

In the production of stop consonants the air is held behind the articulator which closes the oral cavity completely. The time for

which the articulator is held in position resulting in the closure of vocal tract is called closure duration. The results of this indicate that stutterers do not vary from Normally non-fluent children in holding the tract closed for stop consonants.

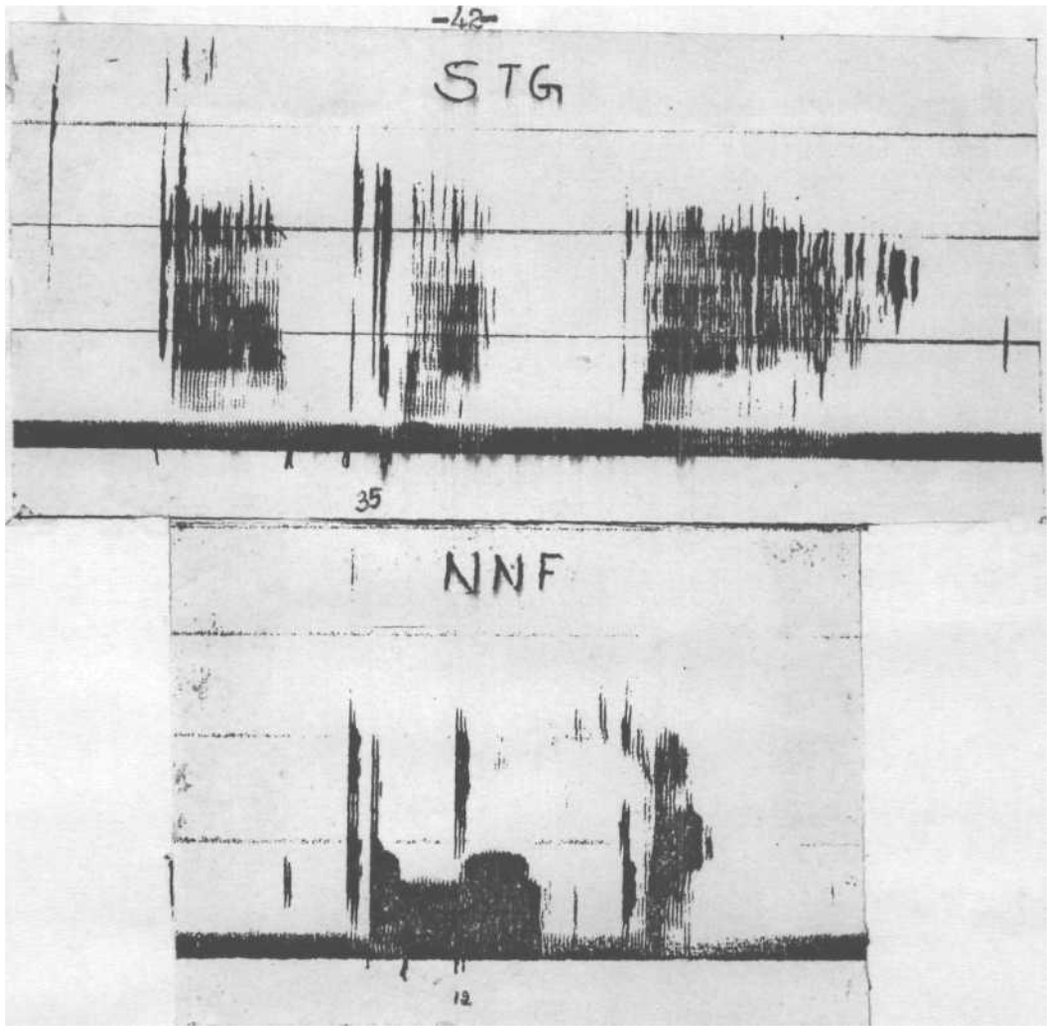
The subjects in the present study, though dipicted articulatory fixations, did not show greater closure durations. It might be because they did not stutter on these words.

5. Burst duration:

The mean burst duration for stuttering group was 11.4 m.secs. and that of Normally non-fluent children was 8.14 m.secs. The burst duration for stutterers was found to be more in stutterers by 3.3 m.secs On T - test it was found that there was significant difference in burst duration between stutterers and normally non-fluent children. Table 4.3 represents the values for burst duration (Spectrogram 4)

	Mean	S.E.	Difference	Probability level
Stuttering	11.4	2.03	3.3	0.0002
Normal non-fluency	8.14	0.99		

Table 4.3: Burst duration of the speech of Stuttering and Normally non-fluent children(in m.secs).



Spectrogram -4: Depicting the burst duration of /g/ in the word /agasa/ (in m.secs.)

This data support the findings of Adams, Runyan, Mallard(l975) and Healey, Mallard & Adams (1976). In the production of stop consonant the articulator is held in the oral tract closing the tract and creating a rapid growth of air pressure with in the oral cavity. When the articulator is suddenly released the air rushes out resulting in audible burst. This release of articulator is termed burst.

The longer burst duration in stutterers indicates that the release of articulators was slow in stutterers. Release of the articulator further is facilitated by muscular activity. Hence during the release of stop consonants the muscular activity may be slowed.

Adams etal (1975) speculated that the longer durations of airflow between consonantal peaks found in their study reflect a decrease in the rate at which articulatory behaviour is being conducted".

The lower velocities are consistent with other reports by Adams, Runyan, Mallard (1975) and Healey, Mallard & Adams (1976). Adams atal (1975) speculated that the longer durations of airflow between consonantal peaks found in their study reflect a decrease in "the rate at which articulatory behaviour is being conducted". Healey etal (l976) showed that longer durations between events are correlated with fluent patterns. They showed that the fluency achieved in singing was accompanied by longer durations of voicing

and presumably of the entire utterance. Furthermore, Starkweather etal (1976), in their study on voice onset time found that when phonological constraints did not demand immediate voicing, the stutterers were found to be significantly slower than normal speakers. Again, the stutterers took more time to produce more normal articulatory behaviours.

It could be suggested that the differences reported in the above mentioned studies might reflect compensatory behaviours which have been learned by the stutterer. Reducing the amount of movement (displacement) and/or increasing the duration of a production might allow the stutterer to gain better control of the motor output. Increasing the duration of movement and lowering the velocity have been shown for the limbs that lowering velocities and lowering displacements improve the accuracy in reaching the target.(Fitts & Posmer, 1967)

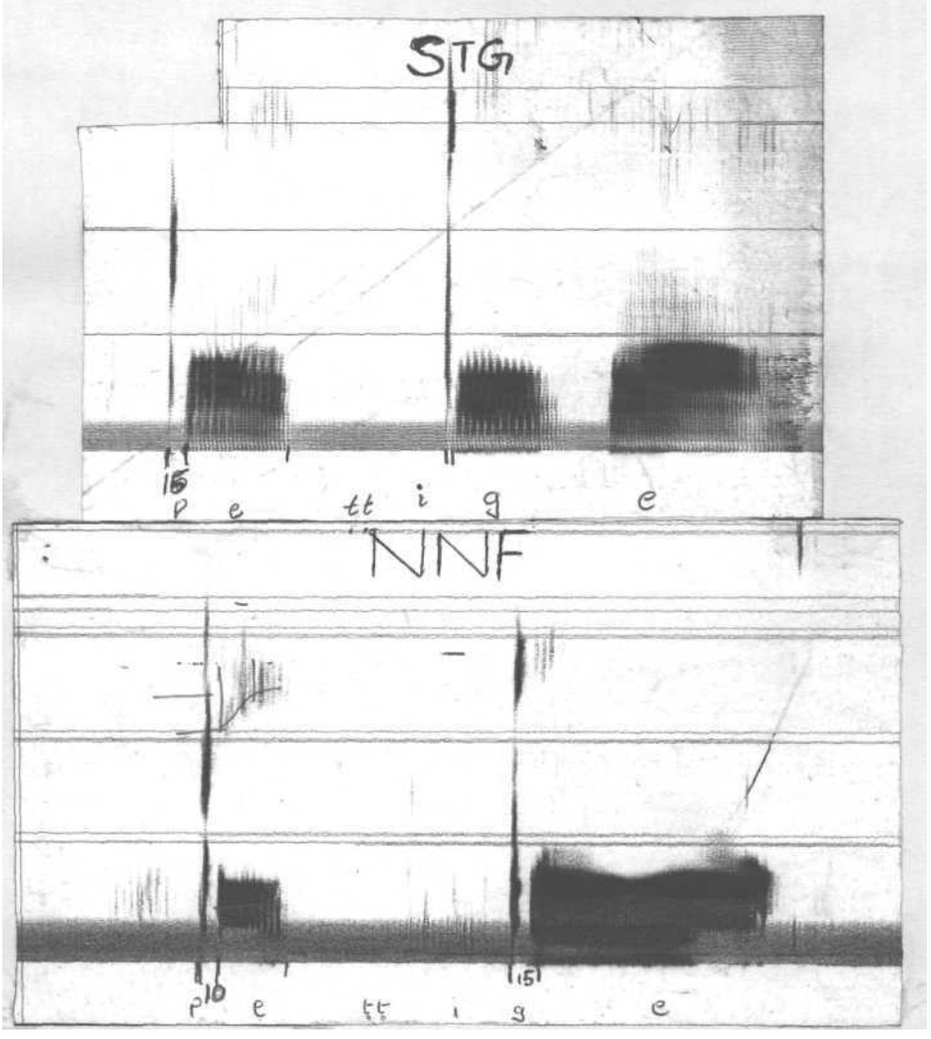
4. Voice onset time (VOT):

The mean VOT for stutterers was 21 m.secs. and for that of normally non-fluent children was 24 m.secs. The VOT was longer

ln the speech of Normalynon-fluent children by 3.6 m.secs. However, no significant difference was found on T-test (Spectrogram -5)

Table:4.4(a): VOT (in m.secs.) in Stuttering & Normally non-fluent Children.

	Mean VOT	S.E.	Difference	Probability level
Stuttering	21	3.89	3.6	0.1340
Normal non-fluency	24	3.39		



Spectrogram - 5: showing the voice onset time for /c/ in the word /pettige/ (in m.secs.)

These results are in consonants with those of Watson & Alfanso (1982) Zebrowski & Conture (1985). However, studies by Agnello & Wingate (1972), Hillman & Gilbert (1977), Metz (l979), Zimmerman (1980) indicate longer VOTs in stutterers.

The relative time of stop release and onset of voicing for the following phoneme is termed voice onset tine and is considered to differentiate voiced from voiceless sounds. In the present study, VOT did not seem to differentiate Normally non-fluent from stuttering group.

Stuttering children exhibited 25.25 m.secs. of VOT for voiceless and 14.16 m.secs. of VOT for voiced. (Table 4.4(b)

	Mean for voiceless sounds	Means for voiced sounds
Normal non-fluency	27.86	15.75
Stuttering	25.25	J4.16

Table A*A(b): VCT in voiced and voiceless sounds (in me.gees)

There was no significant difference between voices & voiceless sounds.

VOT did not seem to differentiate voiced from voiceless in Kannada speaker as found from the present study.

VOT is a sensitive measure for the difference between laryngeal and supralaxyngeal timing. The stutterers laryngeal abnormalities have been reported impling that this timing is disrupted. This is mainly attributed to the posterior crico arytenoid muscle by Schwartz (1975).

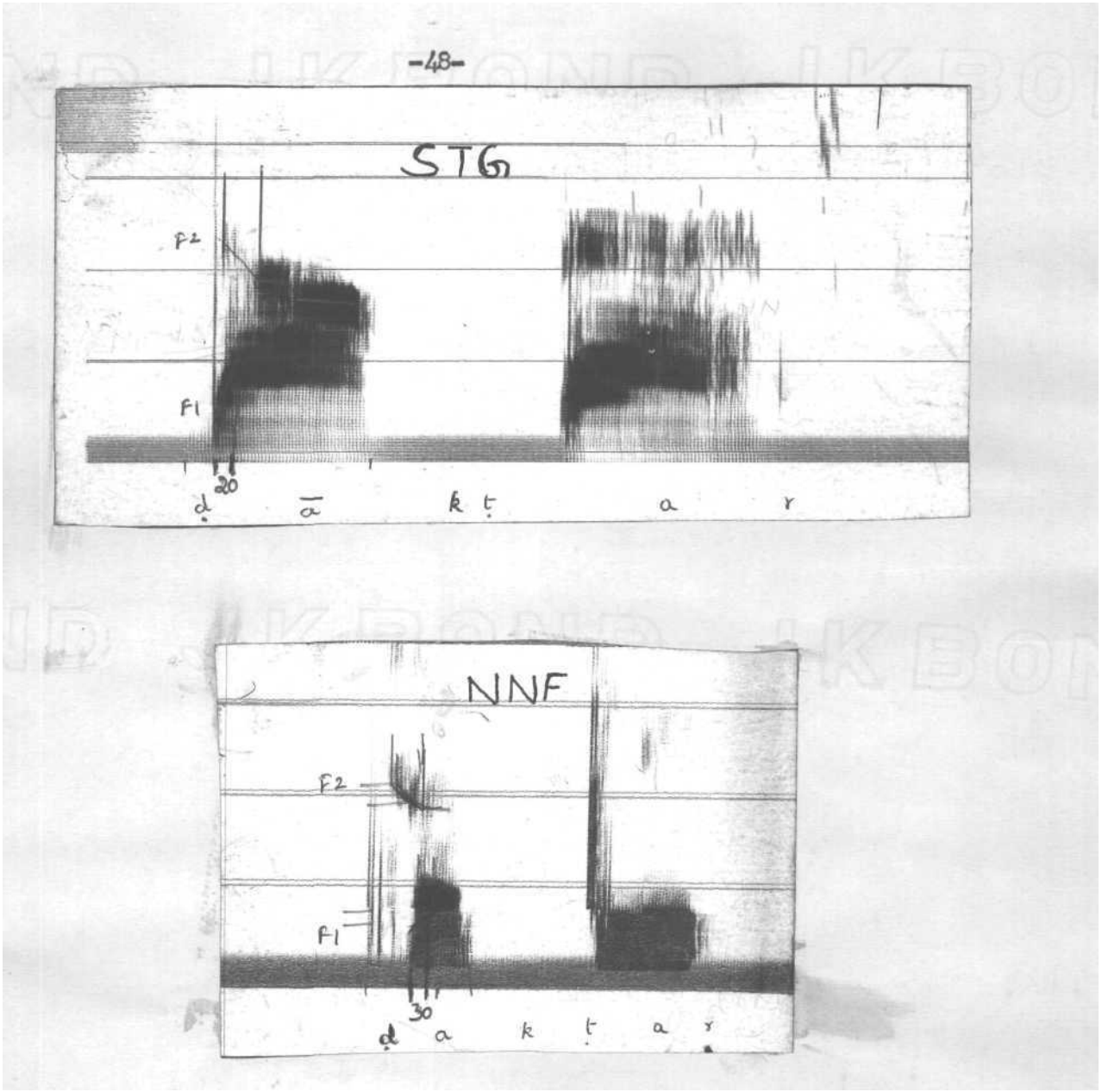
However, the results do not seem to support any of these hypothesis implying that the laryngeal & supralaryngeal timing in the stutterers participated in the study was intact.

5. Transition duration of F1:

The mean transition duration (F1) of stutterers was 19 m.secs. and that of normally non-fluent children was 20 m.secs. and the difference between the two groups was not significant as on T-test. The valuves are in table 4.5 (Spectrogram 6)

	Mean	S.E.	Difference	Probability level
Stuttering	19	1.79	1.38	0.1343
Normal non-fluence	20	2.01		

Table 4.5: Transition duration of stuttering and Normally non-fluent children(in m.secs.)



Spectrogram 6: Depicting the Transition duration /ā/of F1 for the word /d akt ar/

Speech is a continously changing acoustic steam produced by dynamic articulatory proceses. Sounds of speech in context are influenced and altered by their neighbouring sounds. During the production of speech sounds the articulator transit smoothly from one sound to the other. This smooth movement of articulators is

termed transition. The time which the articulators takes to move from one steady position to another steady position is termed transition duration.

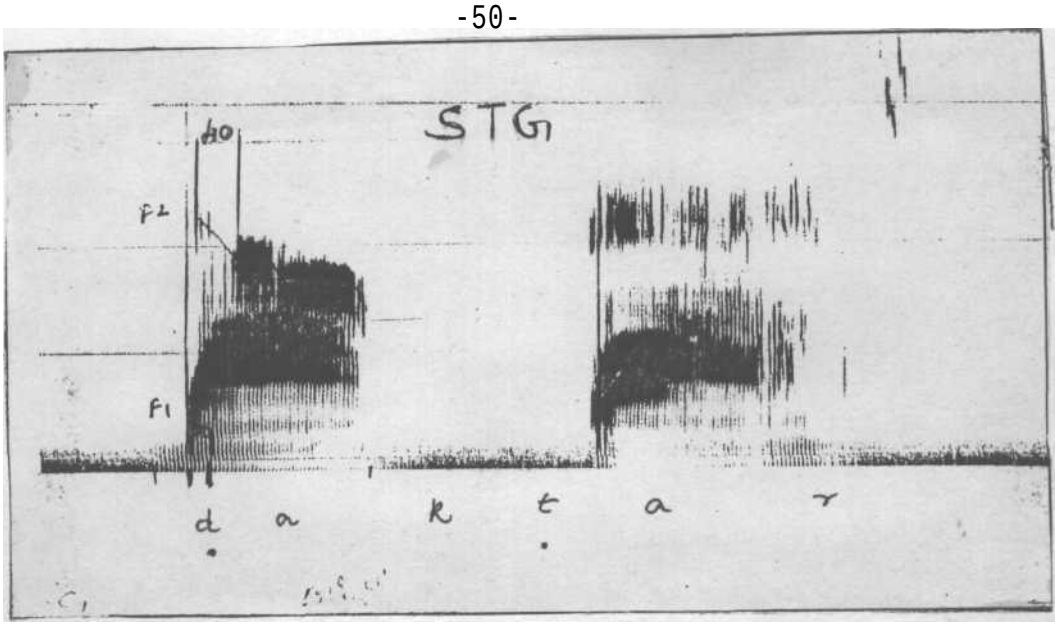
The results of various studies indicates that the stutterers are slow in moving the articulator and in moving them from one position to other. However, in present study they did not show any difference in the transition of first formant. impling that the articulatory transitions were intact for the non-stuttered words in stutterers.

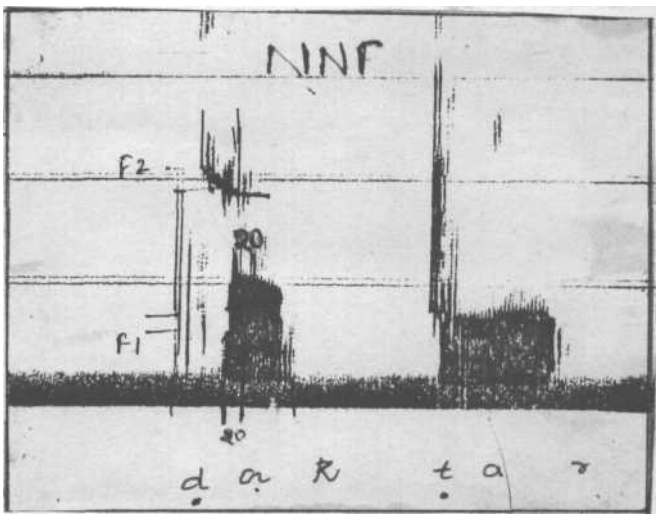
6. Transition duration of F2:

The transition duration (F2) in stuttering group was 30 m.secs. and that in Normally non-fluent group was 31 m.secs. (Spectrogram - 7) The difference between the groups in terms of transition duration (F2) was significant.

	Mean T.D.	S.E.	Difference	Probability level
Stuttering	30	3.44	0.70	0.0001
Normal non-fluency	31	2.34		

Table 4.6: Transition duration (F2) of stuttering and Normally non-fluent children (in m.secs.).





Spectrogram 7: showing the transition duration of F2 in the word. /dakt ar/

This is in par with the results of Starkweather & Meyer (1979). However, in contrary Agnello (1974), Zebrowski & Conture (1985) did not find any significant difference in the transition duration in stutterers.

F2 is directly relate to the position of the tongue in the vocal tract. F2 is low for back vowels and high for front vowels and it especially depicts the horizontal movement of articulator in the tract.

In contrary in the present study it was found that the transition duration (F2) was shorter in stutterers indicating that the stutterers of the present study made faster movements of articulators when transiting from one sound to another. Zimmerman(l980) concludes that the transition durations were longer in stutterers. This may be because stutterers were not able to move their laryngeal and supralaryngeal structures as quickly as non-stutterers. Perhaps stutterer's time plan for executing movements onset is disrupted, resulting in a sluggish ability to initiate co-articulatory transitional movements.

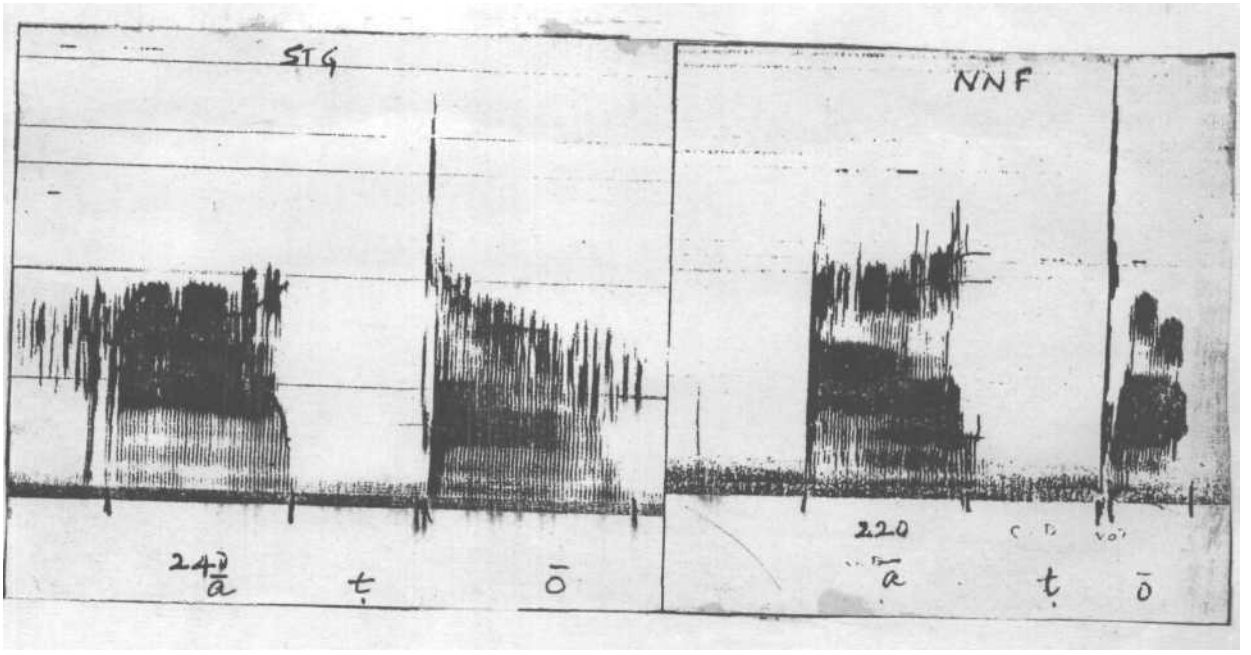
7. Speed of Transition (F1):

The mean speed of transition (F1) of stutterers was 12 Hz/m.secs. and that of normally non-fluent children was 10 Hz/m.secs. (Spectrogram

On T-tests it was found that speed of transition differed significantly between stutterers and normally non-fluent children. The values are depicted in Table 4.7.

	Mean	S.T.	S.E.	Difference	Probability level
Stuttering	12		1.43	1.93	0.0092
Normal non-fluency	10		1.03		

Table 4.7: Speed of transition (F1) in stuttering and Normally non-fluent children.(Hz/m.secs.)



Spectrogram 8: showing the speed of transition/ā/ of (F1) in the word. /atо/

This results agree with that of Webster (1974) in that the speed of transition (F1) was greater in stutterers.

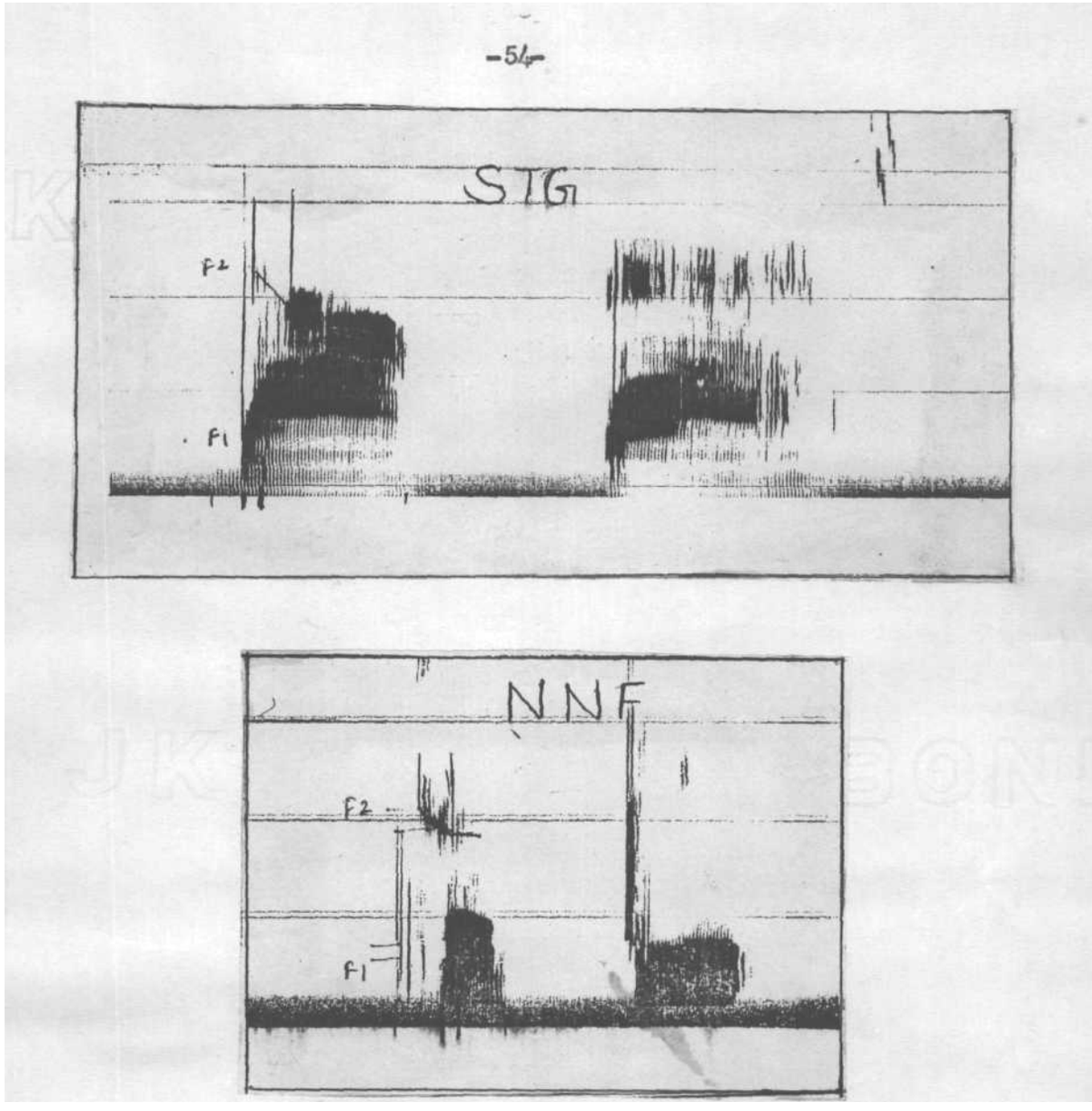
The velocity of the movement of articulators from one sound to another is termed speed of transition. The stutterers in this study showed faster rate of transition than normally non-fluent children impling that the articulatory target position may be different in stutterers (given that no significant differences existed in transition durations).

8. Speed of Transition (F2):

The mean speed of transition (F2) was 9.77 & 8.57 Hz/m.secs. respectively for stutterers and normally non-fluent children. The stutterers had higher speed of transition compared to Normally non-fluent group (Spectrogram 9). On T-tests it was found that speed of transition (F2) did not differ significantly between stutterers and Normally non-fluent children. The values are shown in Table 4.8

	Mean S.T.	S.E.	Difference	Probability level
Stuttering	9.77	0.74	1.20	0.0967
Normal non-fluency	8.57	0.75		

Table 4.8: Speed of transition (F2) in stuttering & Normally- non-fluent children (Hz/m.secs.)



Spectrogram 9: showing the speed of transition /ā/ of (F2) in the word./dakt ar/

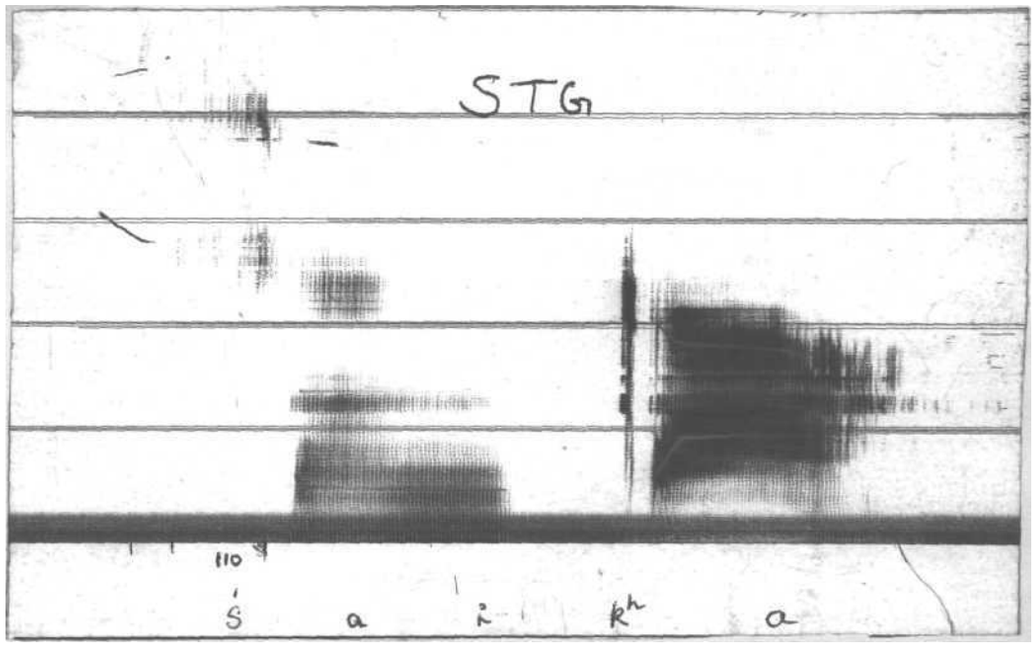
The results of the study by Klich & May (1982) are in par with the present result. However, the results of the study by Zebrowski & Conture (1985) are in contrary. They have found no

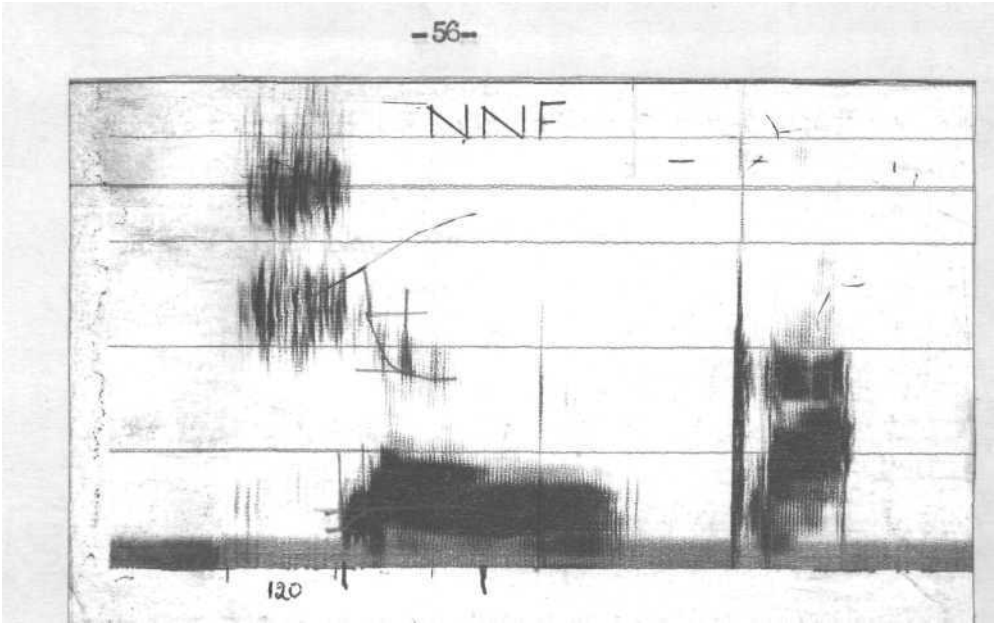
significant difference between Normal non-fluency and stuttering in the rate of transition.

Stutterers of the present study showed faster rates of transition both for F1 & F2. With no significant difference in transition durations, the faster rates imply that articulatory target positions may be different in stutterers.

9. (a) Fricative duration:

The mean frication duration was 124.5 and 108 m.secs. respectively for stutterers and normally non-fluent children. Frication duration among stutterers was found to be 16.5 m.secs. more than that of normally non-fluent children (Spectrogram 10).

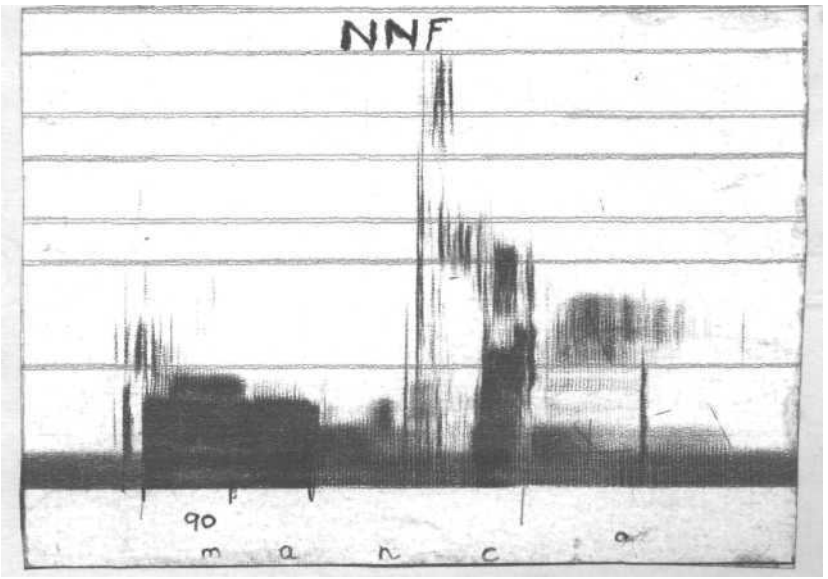


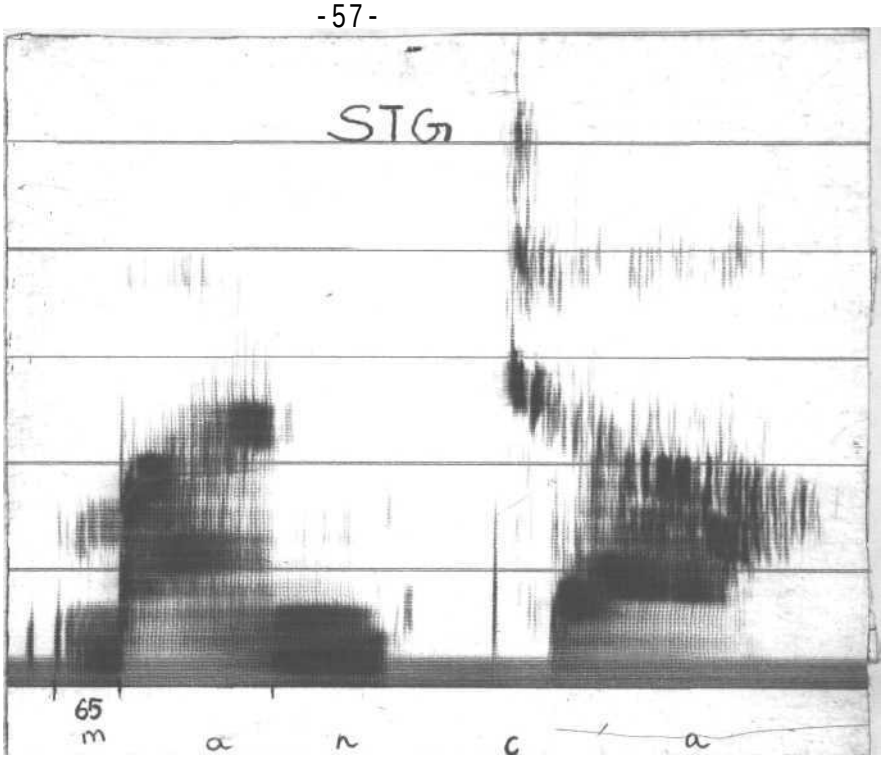


Spectrogram 10: Depicting the frication duration of /ś/ in the ward. /śankha/

9.(b)Nasal Duration:

The mean nasal duration was 82.5 and 92.5 m.secs. respectively for stutterers and normally non-fluent children. Nasal duration was found to be less in stutterers than than of normally non-fluent children (Spectrogram 11).

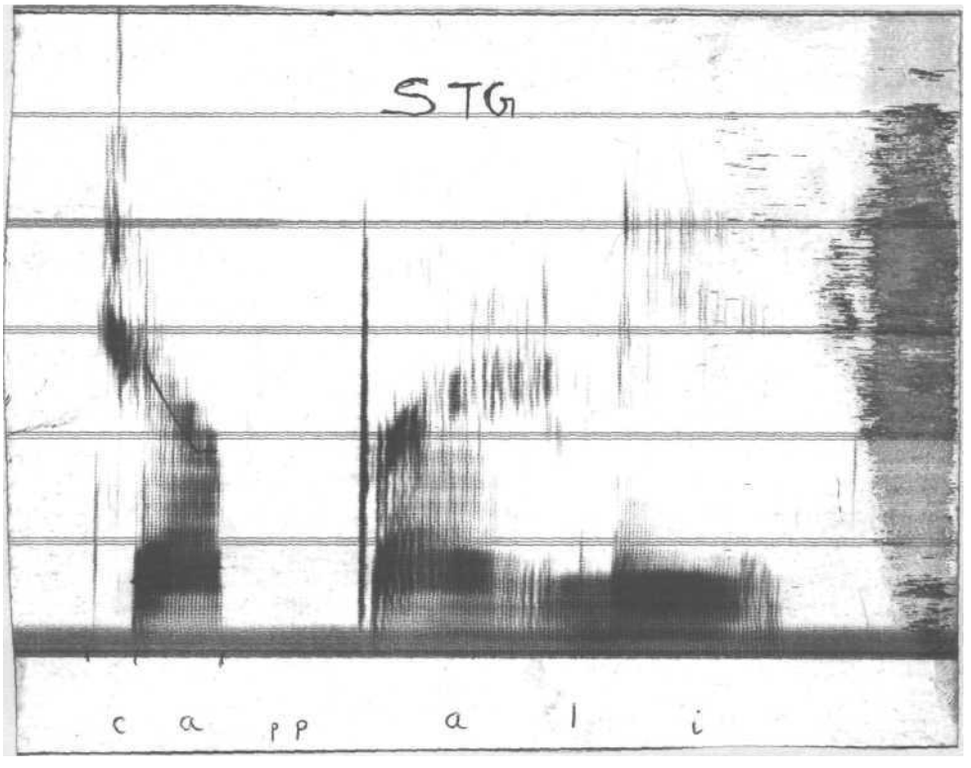


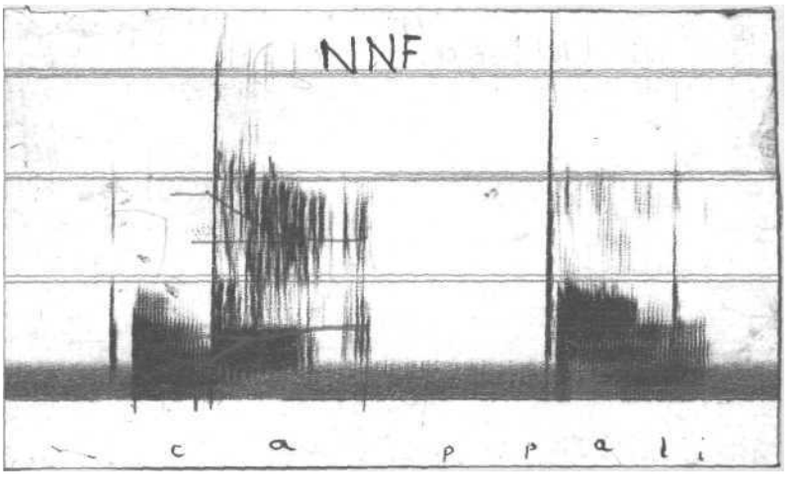


Spectrogram 11: Depicting the nasal duration of /m/ in the word /mancha/.

10. Other Characteristics:

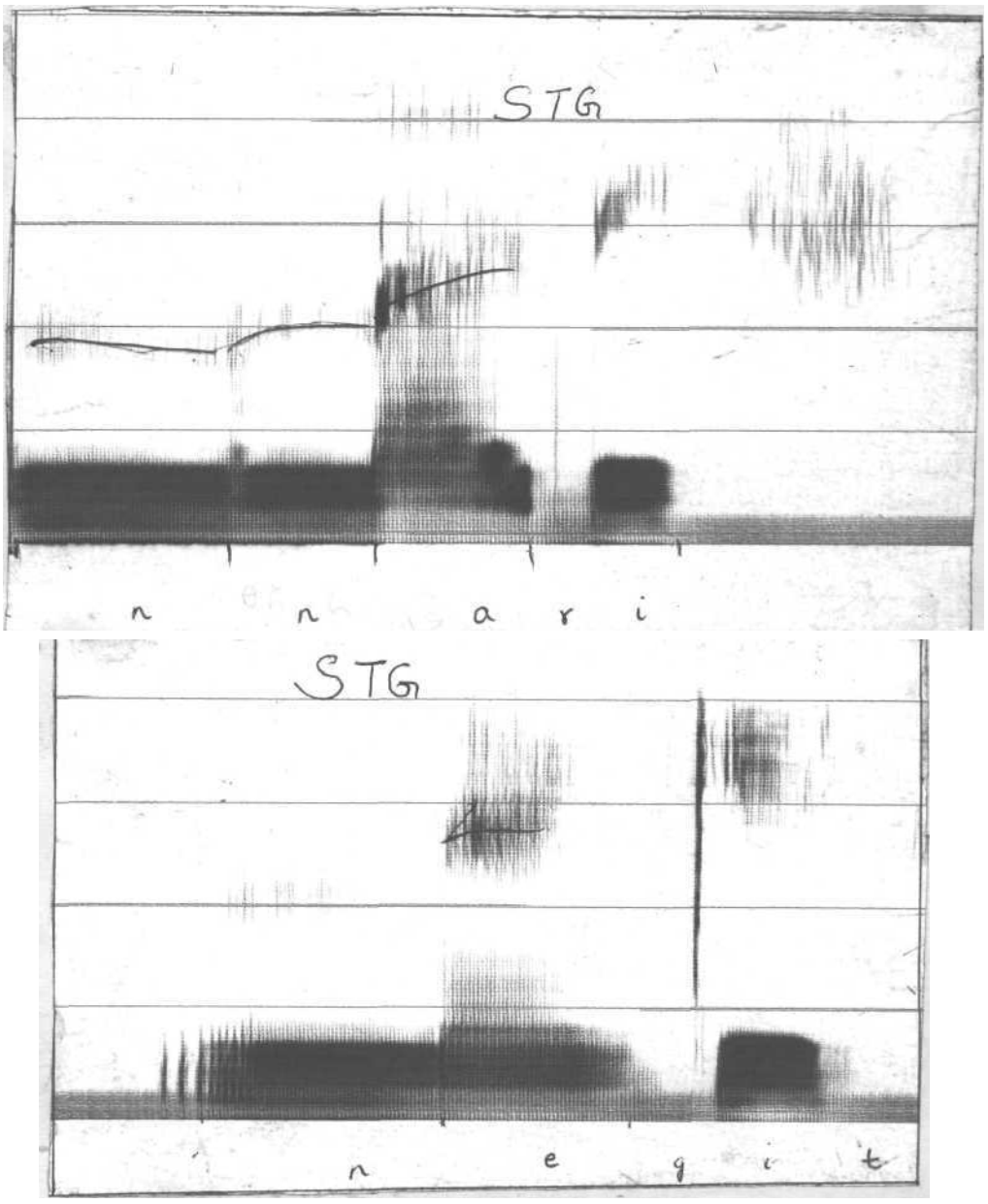
Among normally non-fluent children one subject shoved glottal pulse before the initiation of each word and the second subject showed repetition and prolongation of the initial syllable (for Ex. /ba ba bachan ige/). Also, one of them had voicing (consistantly) for voiceless stops (Spectrogram 12).





Spectrogram 12: Depicting the voicing for voiceless /c/ stop in the word. /cappali/

Among the stuttering children, one of them showed repetion/ prolongation of the initial phoneme as in the words /nari/, and /negītu/ (Spectrogram 15) while repeating it seemed that the subject was unable to transit from the nasal to the next vowel as evidenced by the movement of F2. (Spectrogram 13)



Spectrogram 13: Depicting repetition/prolongation of the initial phoneme in the word /nari/ & /negitu/

To summarize: The following temporal parameters were analysed from the speech samples of Normally non-fluency and stuttering children.

1. Duration of vowels, dipthong and semivowels.
2. Closure duration.
3. Burst duration.
4. Voice onset tins.
5. Transition duration (F1)
6. Transition duration (F2)
7. Speed of Transition (Fl)
8. Speed of Transition (F2)
9. Duration of fricatives and nasals.

The results indicate that the parameters vowel duration, burst duration,transition duration, of (F2) and speed of transition (F1) are capable of differentiating between Normal non-fluency and Stuttering. The vowel duration, burst duration were longer and the speed of transition was higher in stutterers. Transition duration was shorter in stutterers.

The results partially support the notion of Van Riper (1973.) in that stuttering is a temporal disorder.

The present study has contributed though to a little extent, in differentiating between stuttering and Normally non-fluent children. However, large population need to be studied and other perceptual and spectSral parameters should be explored in detail.

- x - x -

CHAPTER - V

SUMMARY AND CONCLUSIONS

Historically more attention has been paid to adult stutterers than to young stutterers. Stuttering is a disorder of early childhood. Available data show that approximately 75% of reported cases of the disorder develop between the second and seventh year of life (Andrews and Harris 1965), Children during this period experience dysfluencies, sons of which are similar to stuttering. Johnson refers to this period as a period of normal non-fluency. It has been difficult to diagnose normally non-fluent children from stuttering children. Though some attempts have been made to differentially diagnose stuttering and normal non-fluency it is not yet very clear.

The present study is an attempt to measure the acoustic temporal parameters, in the speech of normally non-fluent and stuttering children and to find out whether these features assist in differentially diagnosing stuttering and Normal non-fluency.

Two normally non-fluent children and two stuttering children with an age range of 6 - 7 years and with no other speech or hearing disorder served as subjects. The material comprised of pictures of those Kannada words which consisted of all consonants in initial and medial position and pictures for story narration.

The subjects were seated comfortably and were instructed to name the pictures and narate the story (The pictures were presented one at a time). All these were recorded on a high fidelity magnetic spools and were subjected to spectrographic analysis. Wide band bar type of spectrograms were obtained. Using these spectrograms the temporal parameters measured were (1) vowel duration (2) closure duration (5) burst duration (4) VOT (5) Transition duration of F1 & F2 (6) speed of transition of F1 & F2 (7) fricative and nasal durations.

Results indicated that there was significant difference between normal non-fluency and stuttering in the parameters

(1) vowel duration (2) burst duration (3) transition duration of F2 and (4) speed of transition of F1. The other measures revealed no significant differences. Vowel duration, burst duration were longer and speed of transition was faster and transition duration was shorter in stutterers compared to Normally non-fluent children.

* /Also, it aids in parent counselling, in avoiding labelling of a child as a stutterer and in providing parents with more realistic expectations of fluency./

Continued research in the temporal acoustic aspects of stutterer's fluency may increase the understanding of the probable underlying speech physiology associated with both the fluent and stuttered speech of stutterers and hold diagnostic and therapeutic implications. Hence, it is suggested that the other spectral and perceptual parameters of normally non-fluent and stuttering children be studied in detail in a large population. It may provide insight into the cause of stuttering and hopefully in treatment also.

APPENDIX - I

I. Word List:

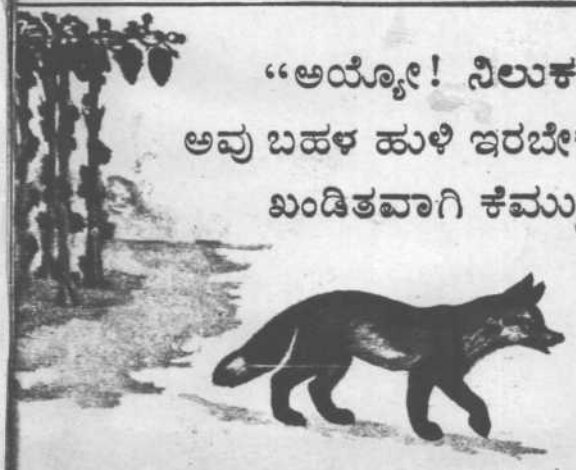
1. ಅಗಸ (agasa)
2. ಆಟೋಲ (āṭōla)
3. ಇಲಿ (ili)
4. ಉಗುರು (uguru)
5. ಊಟ (ūṭa)
6. ಎರಡು (eraḍu)
7. ಎಣಿ (ēṇi)
8. ಒಂಬತ್ತು (ombattu)
9. ಒಂಟೆ (onṭe)
10. ಔಷಧಿ (ausadhi)
11. ಯಮ (yama)
12. ರಥ (ratha)
13. ಲಂಗ (laṅga)
14. ಕಾಗೆ (kāge)
15. ಕಾಲು (kālu)
16. ಕಿಟಕಿ (kiṭaki)
17. ಕುದುರೆ (kudure)
18. ಕೋಳಿ (kōḷi)
19. ಕೈ (kai)
20. ಗೂಬೆ (gūbe)
21. ಚಪ್ಪಲಿ (cappali)
22. ಚಮಚ (camacha)
23. ಛತ್ರಿ (chatri)
24. ಜೇಡ (jēḍa)
25. ಟೇಬಲ್ (ṭēbal)
26. ಡಬ್ಬಿ (ḍabbi)
27. ಡಾಕ್ಟರ್ (ḍāktar)
28. ತಕ್ಕಡಿ (takkaḍi)
29. ದೀಪ (dipa)
30. ನಾಯಿ (nāyi)
31. ಪುಸ್ತಕ (pustaka)
32. ಪೆಟ್ಟಿಗೆ (peṭṭige)
33. ಪೆನ್ನು (pennu)
34. ಬಳೆ (baḷe)
35. ಬಾಚಣಿಗೆ (bācaṇige)
36. ಬೀಗ (bīga)
37. ಬೀಗದ ಕೈ (bīgada kai)
38. ಮಂಚ (mañca)
39. ಸೇಬು (sēbu)
40. ಸರ (sara)
41. ಸೂಜಿ (sūji)
42. ಹೂವು (hūvu)
43. ಹೆಡೆ (heḍe)
44. ಶಂಖ (śaṅkha)
45. ಲೋಟ (loṭa)
46. ವೀಣೆ (vīṇe)

Pictures for Story Narration.

ನರಿ ಮತ್ತು ದ್ರಾಕ್ಷಿಯ ಹಣ್ಣು

ಒಮ್ಮೆ ಒಂದು ನರಿಯು ಸುಂದರವಾದ
ದೊಡ್ಡ ದ್ರಾಕ್ಷಿ ಹಣ್ಣುಗಳ ಗೊಂಚಲನ್ನು
ನೋಡಿತು; ಹಸಿದ ಅದು ಅವನ್ನು ತಿನ್ನಲು
ಹಾತೊರೆದು ಹಾರಿತು. ಅನೇಕಸಲ
ಯತ್ನಿಸಿತು.

ಆದರೆ ಯತ್ನಗಳು ವಿಫಲವಾದವು.
ಅವು ಅದರ ಬಾಯಿಗೆ ನಿಲುಕಲೇ ಇಲ್ಲ.
ಬೇಸತ್ತು ಕೊನೆಗೆ ನಿರಾಸೆಯಿಂದ
ಹೊರಡುವಾಗ ನುಡಿಯಿತು–



"ಅಯ್ಯೋ! ನಿಲುಕದ್ದೇ ಒಳ್ಳೆಯದಾಯಿತು.
ಅವು ಬಹಳ ಹುಳಿ ಇರಬೇಕು. ಅವನ್ನು ತಿಂದಿದ್ದರೆ
ಖಂಡಿತವಾಗಿ ಕೆಮ್ಮು ಬರುತ್ತಿತ್ತು. ತಿನ್ನುವ
ದಡ್ಡತನ ಮಾಡಲಿಲ್ಲ,
ಒಳ್ಳೆಯದಾಯಿತು."

B_I_B_I_L_I_O_G_R_A P_H_Y

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