

NATURALNESS RATING OF STUTTERER'S SPEECH

Reg. No. M 9520

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Amma, Appa and Murali-

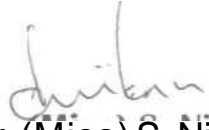
To You, I dedicate this Magnum Opus.

Your love, support, constant encouragement and faith in me are the main stay of my life. You give me the courage to dream and believe in them. Every day, I thank God for dear ones as precious as YOU.

CERTIFICATE

This is to certify that the dissertation entitled Naturalness Rating of Stutterer's Speech is a bonafide work done in part fulfillment for the degree of Master of Science (Speech and Hearing) of the student with Reg. No. 9520


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This is to certify that the Dissertation entitled Naturalness Rating of Stutterer's Speech has been prepared under my supervision and guidance.

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DECLARATION

I hereby declare that the Dissertation entitled Naturalness Rating of Stutterer's Speech is the result of my own study under the guidance of Dr. (Mrs.) S.R Savithri, 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 .

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CHAPTER I

INTRODUCTION

"The ultimate aim of therapy should be to restore or increase the stutters ability to speak in any situation " - Speech Foundation of America (1960)

Therapeutic intervention is aimed at reducing the inability of the individual's ability to speak and to help him cope with most situations. The term ' Speech Naturalness' is used to signify the speech quality and is used in stuttering research. The first study in this area was by Martin, Haroldson and Triden (1984). Although work in this area began much earlier, the first study has been attributed to these three researchers. However, no definition of speech naturalness has been proposed . In most of the studies , the judges are to rely on their understanding and definition of the term naturalness . It appears that speech naturalness refers to the perceptual characteristic of an individual's speech. Although it seems like the term 'normal' , these are not synonymous / interchangeable .

The impetus to study speech naturalness arose from the observations of Martin et al . , (1984) that following any fluency therapy , the overall speech patterns are relatively fluent . However , their speech sounds slow, paced and monotonous . This is a finding that is supported by others including Ingham , Onslow and Finn (1989); Runyan , Bell and Prosek (1990)

Martin et al. , (1994) found proof for their hypothesis when their study evidenced that inspite of complete fluency following therapy , the judges were able to differentiate the samples of stutterers from those of non-stutterers This finding has been replicated by most others including Ingham , Gow and Costello (1985), Onslow and Ingham (1987) , Onslow Haynes , Hutchins and Newman (1992), Onslow , Adams , and Ingham (1992).

Whilst earlier studies incorporated various rating scales and other modes for judging , the 9-point scale has remained the most popular. Martin et al , (1984) found this scale to be reliable and other researchers (Ingham et al ., (1985), Onslow and Ingham (1985), Martin and Haroldson , (1992) supported this finding .

Some studies also used sophisticated / unsophisticated listeners as judges and reported that in both the groups of listeners, the consistency, agreement and reliability of both groups were in consonance with each other . (Onslow , Adams and Ingham , (1992)) . Onslow et al., (1992) and Martin et al ., (1992) found that the severity of pre-treatment stuttering correlated with the naturalness score given after therapy However Runyan , Bells and Prosek (1990) found no such difference .

Studies have also indicated that providing feedback to the stutterers at various stages during therapy of the naturalness can lead to variation in naturalness as therapy progresses . (Ingham , Martin , Haroldson , Onslow and Leney, (1985), Onslow and Ingham (1985), Runyan et al., (1990) . Their

findings also indicated an improved naturalness ratings with instruction on modifying naturalness

Most studies , as already mentioned , do not define or incorporate parameters used for naturalness . Studies by Ingham , Montgomery and Ulliana, (1983) and Agnello (1987) did make an attempt to give the parameters . However , because the studies were preliminary no conclusions were reached . It is important that the specific parameters be available for rating naturalness . In this context, the present study was planned .

The aims of the study were two fold and were as follows .

- (i) To find out the parameters which , according to the unsophisticated listeners , contributed to speech naturalness / unnaturalness , so that a naturalness scale can be made and
- (ii) to investigate the speech naturalness in the pre and post therapy samples of stutterers as rated by unsophisticated listeners across the parameters

CHAPTER II

REVIEW OF LITERATURE

Though the study of Speech Naturalness is recent , concern regarding the speech quality of the stutterer's speech following therapy began much earlier.

Parrish (1951) may have been first to argue that *the concept of naturalness* is at the heart of many notions about desirable speech behaviour . He also highlighted the importance of distinguishing between a speaker's judgement of natural speech production and a listener's judgement of natural sounding speech . The first serious attempt to measure listener judged speech naturalness occurred in a study by Nichols (1966). Nichols had 20 listeners rate separately written and spoken sentences from normal speakers for levels of naturalness using a 9 - point scale that merely specified 1 as high naturalness and 9 as low naturalness . The main finding was that sentence vocabulary level appeared to influence the level of naturalness ratings . However , the individual naturalness ratings proved to be rather unreliable (although the group ratings had better reliability), which may explain why this was not taken further for normal communication research . Nevertheless , naturalness ratings were subsequently used for synthesized speech (Gramlich , and Levine 1981) , voice quality of dysphonics (Stoicheff, Ciampi , Passi , and Fredrickson , 1983 ; Blaugrund , 1984) and dysarthric speech (Wolfe , 1984).

The first investigation in this aspect in stuttering was carried out by Jones and Azrin (1969). They measured the effect of various durations of vibrotactile rhythmic signal on stuttering. A group of listeners were asked to judge speech samples obtained from four stutterers as natural or unnatural. It emerged that the highest percentage of judges scoring speech as natural was related to the speech that contained stuttering while stuttering free speech samples received relatively few natural judgements i.e listeners regarded rhythmic speech with the stuttering as more natural sounding than stuttering - free rhythmic speech .

Ingham and Andrews (1971) compared different categories of residual stuttering that remained in the later part of intensive treatment programmes using either rhythmic or prolonged speech . Measures were made on the frequency of stuttering that occurred within these categories , rather than the speech quality per se . Although it was found that more stuttering remained following therapy using prolongation , *the study failed to determine which speech quality was regarded to be superior .*

Hallard (1979) recorded preference order for stuttered speech syllable timed speech at 70 words per minute (wpm) and syllable timed speech at 100 wpm as produced by three stutterers . The listeners showed a clear preference for syllable timed speech in two subjects but their preference was reversed for the other subject. Also, all of them preferred the 100 wpm speech over the 70

wpm speech . This study implies that *speech rate does not influence judgements.*

These were the only investigations on the speech quality of stutterers during rhythmic stimulation conditions . Following this , the other attempts to evaluate treated stutterers' speech quality emerged from investigations that used prolonged speech or its variants

Perkins , Rudas , Johnson , Micheal and Curlee (1974) studied stuttering frequency , speech rate and listener judgement on three , four point rating scales . These scales which prescribed normal and abnormal at each extreme were used to record judgements of either fluency , prosody or speaking rate from one minute samples of the subjects speech *A variability in the speech quality rating with respect to the treatment used was found.*

The solution to the problem of selecting an appropriate control in perceptual analysis is to use some type of pre test for selecting normally fluent speakers . Under this strategy Frayne , Coates and Marriner (1977) employed a perceptual analysis technique to investigate the speech quality of stutterers who had been treated by a prolonged speech procedure . 27 listeners were provided with two different recordings containing speech samples of stutter-, free speech from 10 treated stutterers ((6 - 18) months following therapy) and similar samples from 10 controls . For the first recording , listeners were asked to judge the speaker as normal or abnormal and make a rating for speech rate and smoothness on a 9 - point scale . Then the listeners

were given different speech samples of the stutterers and rate each sample for normality , hesitation and intonation on a 9 - point scale Results showed that their listeners generally failed to distinguish between the samples from the stutterers and non - stutterers , although the range of smoothness ratings for stutterers was greater than for non stutterers. These positive findings were attributed to two factors (a) The listeners were never asked to judge whether these samples were from a stutterer or non - stutterer and (b) Listener heard relatively short speech samples. *This was one of the first studies that used the 9-point rating scale. Although this was not used for the rating of naturalness per se in this study , it found a great deal of popularity in later studies of speech naturalness.*

Ingham and Packman (1978) used 9 non - stutterers and 9 stutterers who were stutter free after completing the initial phases of a prolonged speech treatment program as their subjects Three different groups of listeners used the fluency, prosody and rating devised by Perkins et al., (1974) and the natural / unnatural judgement system used by Jones and Azrin (1969) . Their results indicated that listeners failed to distinguish between the stutterers and non - stutterers samples However , when ten other listeners were asked to make a dichotomous (stutter or normal) judgement , the judgement did distinguish between the stutterer's and non - stutterer's samples *Although the stutterer's post - treatment speech was judged to be normal in terms of prosody , fluency , rate and naturalness , it did still retain certain identifying features .*

Also as part of their study , Ingham and Packman (1978) , paired the treated stutterers speech sample with a sample from a non - stuttering speaker . Listeners were asked to choose which sample was from a treated stutterer . But this procedure has its limitation as it fails to quantify normalcy or indicate how much normalcy exists in a stutterers speech. (Jacono , 1984).

Runyan and Adams (1978 , 1979) used forced choice perceptual analysis procedure in their investigation of the speech quality of successfully treated stutterers . These stutterers were treated using different therapy techniques - Van Ripenan , metronome , conditioned speech retraining , delayed auditory feedback , Operant conditioning , precision fluency shaping or holistic therapy . Stutter free speech samples from these subjects and non - stuttering speech samples were used . The sophisticated (Runyan and Adams, 1978) and unsophisticated (Runyan and Adams, 1979) listeners were asked to choose partially treated or treated stutterers. They were able to distinguish between the two groups at better than chance level of accuracy. However, the unsophisticated listeners were unable to distinguish between the Van - Ripen method treated stutterers from normals. Runyan, Hames and Prosek (1982) later showed that the general findings of Runyan and Adams (1978,1979) were the same regardless of whether listeners heard paired samples (stutterer and non-stutterer) or randomly presented samples. However, it has limited practical value in a clinical setting and the nature of difference was not revealed.

In a similar study, Florence and Shames (1980) asked 19 listeners to judge the origin of 15 second samples from 32 non-stutterers and 32 stutterers at various phases of the Florence and Shames (1980) therapy program. They found that similar number of listeners judged the non-stutterers and the stutterers (at the time of termination) samples to have come from stutterers. Thus, it was presumed that stutterers achieved essentially normal speech. However, the mere fact that the listeners made relatively few stutterer judgements is not sufficient reason to claim that the stutterers (or the non-stutterers) had achieved normal sounding speech.

In all the above mentioned studies, observers were not required to scale and quantify their perceptions of speech naturalness. However, if speech naturalness was to be used clinically, it was realised that it must be determined empirically whether speech naturalness is a useful and scalable phenomenon. Scaling naturalness should provide a means for differentiating, in terms of numerical scale values, between both groups and individuals. The procedure should provide for differentiation, in terms of numerical scale values among various stages or phases of treatment. It was with this in mind that the first "naturalness" study was conducted.

Before reviewing the recent studies on speech naturalness, the earlier studies will be analysed briefly. The methodological considerations of these studies varies greatly. They ranged from identifying stutterer's speech, classifying speech as normal or abnormal to the presently used 9 -

point rating scale. Also, the aspects studied varied from rate, severity, intonation to nasality. While the results of some studies revealed no difference between samples of stutterers and non- stutterers, some did find these differences.

STUDIES ON SPEECH NATURALNESS

The word 'natural' does bring to mind a number of words associated with it, including the word 'normal' . While it is easy for one to define what is referred to as 'normal' , 'natural' is a much more difficult entity to define. This could be attributed to wide variations in the so-called normal speech and the wide variety of the listener types, exposure and tolerances . It is probably this that has caused all researchers to refrain from defining this term in their studies.

As already mentioned, prior to the study by Martin, Haroldson , and Triden (1984), there were many varied methodologies used to study naturalness. However, following their study , they managed to prove the reliability, validity and consistency of the 9- point rating scale used by them . Following this, most other studies have incorporated the methodology of not defining naturalness and using the 9- point rating scale.

In their study Martin, Haroldson , and Triden (1984) used 10 stutterers speaking under 250 ms delayed auditory feedback and 10 non-stutterers. 30 unsophisticated listeners were used as the judges. Results of this study indicated that the stuttering samples were judged as sounding significantly

more unnatural than the non-stutterer samples. The DAP stutter-free samples were also judged as sounding significantly more unnatural than the non-stutterers' samples. The stutterer's and DAP stutter-free samples were not judged as sounding significantly different in terms of speech naturalness. Such results were also replicated by Ingham, Gow, and Costello (1985), Ingham, Onslow and Finn (1989); Runyan, Bell, and Prosek (1990); Onslow, Hayes, Hutchins and Newman (1992), Martin and Haroldson (1992). In each of these it was found that the post-therapeutic stutterer's speech was significantly more unnatural than the non-stutterer's speech. Studies by Ingham, Costello, Onslow, and Finn (1989); Runyan, Bell, and Prosek (1990); Onslow et al., (1992) have also indicated that the pre-therapy speech sounded more unnatural than the speech sample obtained post-therapeutically.

LISTENER TYPES

Studies on naturalness have been carried incorporating both sophisticated and unsophisticated listeners. Martin et al., (1984) in the first study used unsophisticated listeners. They found the inter-rater reliability, inter-rater agreement and rater consistency for judging speech naturalness to be satisfactory. Ingham, Gow and Costello (1985), Martin and Haroldson (1992) also were among others who incorporated unsophisticated listeners in their respective studies. They reported high degree of reliability, consistency and agreement in their judges.

Most studies incorporating sophisticated listeners are those which include treatment of the stutterers i.e. , providing naturalness ratings during the treatment phase to check for variation and treatment effects (Ingham et al . , 1989 ; Onslow and Ingham 1985 ; Runyan et al . , 1990) . However , Onslow, Adams and Ingham (1992) evaluated sophisticated and unsophisticated listeners who judged on a 9- point scale , the speech naturalness of speech samples from 10 stutterers enrolled in a treatment program incorporating prolonged speech . The ratings were made by different groups of judges at 15 second , 30 second and 60 second intervals. Interclass correlation was found to be significantly higher for the sophisticated judges , although the consistency and agreement of unsophisticated judges was generally equivalent to that of sophisticated judges . Also , 60 second interval proved better in terms of agreement scores and interclass correlations when compared to 30 second intervals.

While studies utilised spontaneous speech samples (Martin et al . , 1984 ; Ingham et al . , 1985 ; Ingham et al . , 1989 ; Runyan et al . , 1990 ; Onslow et al . , 1992 ; Martin and Haroldson 1992) . Onslow , Hayes , Hutchins and Newman (1992) studied the naturalness ratings given to monologues and conversations. The results indicated that the naturalness ratings obtained were similar regardless of the sample used.

STUTTERING SEVERITY AND SPEECH NATURALNESS

It is also reasonable to assume that there will be some relation between the pre-treatment stuttering severity and post-treatment speech quality. Clients with a severe problem may need to use a more exaggerated (less natural sounding) post treatment speech in order to eliminate stuttering . In Runyan and Adams (1978) study, cases of "severe" pre - treatment stuttering were easiest for the listeners to distinguish from non- stutterers, 'moderate' clients the next easiest to distinguish from non - stutterers and 'mild' the most difficult. Onslow et al ., (1992) also found significant positive correlation between pre - treatment speech measures and measures of speech naturalness made after the establishment of stutter - free speech. The subjects whose pre - treatment stuttering was the most severe had post - treatment scores that were more than two scale values worse than the subjects whose pre -treatment stuttering was least severe. Ingham and Onslow , 1985 found that the subjects who ended therapy with the most natural speech were found to have least 'percent syllable stuttered' prior to initiation of therapy .

However, Runyan, Bell and Prosek (1990) found no difference in the post - treatment naturalness ratings of stutterers rated as mild, moderate and severe before treatment . The reasons for this variation have been attributed to reduced duration of speech samples, variety of therapy techniques used and the nominal categories for measuring pre-treatment severity (Onslow et al., 1992).

Martin and Haroldson (1992) also found that when judges were asked to rate severity of stuttering and naturalness ; samples judged as high severity were also judged as unnatural. Also, a high correlation was found to exist between mean speech naturalness and the percentage of words stuttered and the number of words in the sample

The only study where in the rate of speech was systematically analysed was Onslow and Ingham (1985) . They found a reciprocal relationship between the increase in the subject's syllable per minute (spm) scores and naturalness ratings. Also, subjects with highest spm prior to the initiation of therapy ended therapy with the highest naturalness scores. Ingham et al ., (1984) found that only some ratings made by their listeners were influenced by the stuttering frequency and rate of speech

THERAPEUTIC CHANGES

Perceptual analysis procedures have also been used to investigate changes in speech quality that may occur as a result of other treatment techniques. In an earlier study , Williamson , Epstein and Colburn (1981) evaluated speech quality on regulated breathing treatment by a social validation procedure in which 30 listeners were asked to rate their subjects speech sample on different scales . Their ratings indicated that as the subjects speech improved , the listeners desire to interact with them and their "global social impression" of the subject also improved . However, the scores also implied that they may not have judged subjects speech to be completely acceptable .

Although the social validation procedure has some merit , these dimensions may not always refer to the speech quality.

Ingham , Martin , Haroldson , Onslow and Leney (1985) were among the first to systematically study the effect of regular feedback to the stutterer undergoing treatment in terms of his naturalness rating on a 9-point scale. The results indicated that naturalness ratings and stuttering changed favorably for five out of six . Onslow and Ingham, (1985) have indicated the change in naturalness ratings across the treatment phase of 5 adolescent stutterers . They found that in the first phase of therapy , when prolonged speech and shaping occurs , the subjects speech is initially extremely unnatural sounding and gradually becomes more natural as the speech rate is systematically increased . This improvement continued until the stage of transfer phase although the individual rates of improvement of each stutterer varied . They also found that by providing feedback to the stutterer , the speech naturalness could be modified towards a target level of speech naturalness

Ingham et al., (1989) also evaluated the effects of specific instructions to stutterers to rate and modify how natural their speech sounds on experimenters' rating of speech naturalness , stuttering frequency and speaking rate . This study too indicated that stutterers could modify their speech to increase or decrease the naturalness ratings . These changes were found to be independent of stuttering frequency or speaking rate . Measures or ratings of how natural speech " sounded" and "felt" varied in one subject.

Runyan , Bell and Prosek (1990) compared the speech naturalness ratings of perceptually fluent speech samples produced by non-stutterers and stutterers who had been treated in different therapy programs . No significant difference was reported in the naturalness ratings depending upon the type of treatment used . Martin and Haroldson (1992) incorporated the use of unsophisticated listeners and the 9-point rating scale to judge separate audio only and audio visual presentations of stutterers and non stutteres samples . They found that the stutterers were judged more unnatural on the audio visual presentation when compared to the audio presentation . However, the magnitude of this difference was quite small.

Kalinowski, Stuart, Sark and Armson (1996) following their study on feedback delays conclude that alterations in speech motor strategies which enhance fluency usually have an adverse effect on speech naturalness ie, speech produced by concious alteration of the motor plan is percieved to sound unnatural . However , they found that fluent speech produced under altered auditory feedback is judged as sounding natural - both by subjects and the experimenter's involved .

These studies indicate the need for rating the speech naturalness of stutterers as a means of feedback for improving their speech as well as to identify the efficacy of therapy which aids in the termination of therapy. While these studies have used the term ' Naturalness' it has not been defined . It

would be better if the parameters of naturalness are specified so that the client can be directed to improve on a particular parameter . In this context the present study aims at developing a naturalness scale with specified parameters and rating the speech naturalness of stutterers using the scale.

CHAPTER III

METHODOLOGY

I. PILOT STUDY

A pilot study was conducted with the following methodology

SUBJECTS

20 stutterers in the age range of 12 to 29 years and three normals in the age range of 18 to 21 served as subjects. Table-1 shows the age and sex distribution of the subjects.

Age range	Stutterers		Normals	
	Males	Females	Males	Females
10 to 20 Years.	9	1	1	1
20 to 30 Years.	10	-	-	1
Total	19	1	1	2

Table-1 : Subject details

MATERIAL

The spontaneous speech of 20 stutterers before and after therapy were audiorecorded. Of these samples, thirteen pre-therapy and thirteen post-therapy samples were dubbed onto another cassette. Of the thirteen pre-therapy samples, two samples were repeated to check for reliability. Also, samples from three normal subjects were dubbed to this cassette. These 29 samples were randomized and audiorecorded, which formed the material.

METHOD

These samples were audio presented to three sophisticated (Post-graduates in Speech and Hearing) listeners and three unsophisticated listeners (unrelated to the field of Speech and Hearing) in the age range of 19 to 23 years. They were instructed to rate the samples from one (highly natural) to nine (highly unnatural) (Appendix - A) . The definition of "naturalness" was not provided to any of the listeners. All the sophisticated listeners were to judge the samples again after a period of two or more days. This was done to check the reliability.

ANALYSIS

I . Percent dysfluency : Verbatim transcription of each sample was prepared and each stuttering event was marked. The percent dysfluency was calculated using the following formula :

$$\text{Percent dysfluency} = \frac{\text{Total number of stuttering}}{\text{Total number of words}} \times 100$$

II . Rate of Speech : The total time of each speech sample was calculated using a stop watch. The rate of speech was found 'in words per minute using the following formula :

$$\text{Rate of Speech} = \frac{\text{Total number of words}}{\text{Total time taken (in seconds)}} \times 60$$

III . Mean Naturalness Scores (MNS) : The ratings given by each of the listeners were used to compute the mean naturalness score for each sample

(separately for sophisticated and unsophisticated listeners). This was calculated using the following formula

$$MNS = \frac{MNS_1 + MNS_2 + MNS_3 + \dots + MNS_N}{N}$$

Where MNS_1, MNS_2, \dots , etc., are the ratings given by different listeners for a single sample and N is the total number of sophisticated /unsophisticated listeners who judged the sample.

IV. STATISTICS : To examine the significant difference between the MNS of sophisticated and unsophisticated listeners 'T' test was carried out Using product-moment coefficient of correlation, the correlation between mean naturalness scores and percent dysfluency , rate of speech and the reliability in the rerating task was calculated .

II MAIN STUDY

The results of the pilot study indicated that the 9 - point scale was unstable and 2 -point scale could be more beneficial . The main study was conducted in two parts. Part I involved development of speech naturalness scale and Part II consisted of naturalness ratings of speech samples on specified parametres by sophisticated judges.

PART I. DEVELOPMENT OF SPEECH NATURALNESS SCALE

SUBJECTS

The subjects in this part of the study were 60 Post - Graduate normal students in the age range of 20 to 23 years unrelated to the field of Speech and

Hearing (Graduate students from the University of Mysore and University of Bangalore).

METHOD

The subjects were provided with a response - sheet (Appendix A) They were instructed to write the parameters that they think contribute to the naturalness / unnaturalness of speech. An introduction was given by the experimenter regarding the task. No information was provided regarding the naturalness or unnaturalness aspect of speech. (Appendix B)

ANALYSIS

Responses were tabulated and analyzed in terms of the parameters considered by the subjects for the naturalness of speech. The percent times the parameters indicated naturalness was calculated by the following formula.

$$\% \text{ a parameter indicated (naturalness)} = \frac{\text{No. of subjects indicating the parameter}}{\text{Total No. of subjects}} \times 100$$

All the parameters were ordered according to the percent weightage and only those parameters with a weightage of 20 % or more was considered in the naturalness scale.

NATURALNESS SCALE

The naturalness scale consisted of all the parameters with a weightage of 20 % or more and were arranged according to percentage weightage. It also included the overall naturalness rating.

PART II. RATINGS ON SPEECH NATURALNESS SCALE

MATERIAL

The material consisted of reading and spontaneous speech samples of 34 stutterers before and after therapy and also samples of seven normal subjects. Table 2 shows the details of the subjects.

Age range	Stutterers		Normals	
	Male	Female	Male	Female
10 - 20 Years	14	2	3	2
20 - 30 Years	17	1		2
Total	31	3	3	4

Table-2 : Subject details

Pre-therapy spontaneous speech and reading samples were recorded prior to therapy assignment and post-therapy spontaneous speech and reading samples were recorded at the time of termination of therapy. All the stutterers underwent fluency therapy with prolongation technique which included the learning of prolongation , transfer , maintenance and generalization phase. Speech therapy was terminated when stutter free speech was established outside clinic situation . Spontaneous speech samples consisted of narrations about their school / college , work schedule and for reading sample standardized reading passages (Kannada or Rainbow passage in English) were used . All the speech and reading samples were audio-recorded in the Speech Science lab of the All India Institute of Speech and Hearing. Among these speech samples , 32 were of pre-therapy , 29 post- therapy and 7 normal

speech and reading samples were separately audio recorded. 7 samples were repeated randomly in order to check intra judge reliability . Thus , the material consisted of two cassettes, viz : one with 68 one minute spontaneous speech samples and another with 68 one minute reading samples (7 normal, 32 pre-therapy , 29 post therapy samples). Each sample was preceded by a number.

SUBJECTS

Six subjects unrelated to the field of speech and hearing were used as judges (five male and one female). Of these , three were normal speakers and unsophisticated listeners , while three other judges were stutterers attending therapy at All India Institute of Speech and Hearing , Mysore . All the subjects were familiar with Kannada and English .(Appendix C).

METHOD

The subjects were tested individually. They were provided with a response sheet indicating various parameters for the speech naturalness scale (developed in Part-I of the study). They were to listen to each sample audio presented and were to rate the naturalness of the sample on each parameter on a binary scale with '1' representing natural and '0' representing unnatural. They were also to rate the overall naturalness of the sample. As the subjects had to rate 136 samples (68 reading and 68 spontaneous speech samples on various parameters), they were instructed to stop the task when they felt fatigued. Each subject rated the sample over a weeks time and they could hear the samples as many times as possible .

ANALYSIS

1. Percent dysfluency : Verbatim transcription of both the reading and spontaneous speech samples of stutterers before and after therapy was done.

Percent dysfluency was calculated by the following formula :

$$\text{Percent dysfluency} = \frac{\text{Total number of stuttering}}{\text{Total number of words}} \times 100$$

2. Rate of Speech : The number of words uttered per minute were calculated by the following formula .

$$\text{Rate of Speech} = \frac{\text{Total number of words}}{\text{Total time taken (in seconds)}} \times 60$$

3. Statistical Analysis : The subjects' ratings were tabulated separately and were grouped for normal, pre-therapy and post therapy samples of reading and spontaneous speech task. Naturalness Ratings given by each judge (for normal pre-therapy and post-therapy samples) were calculated in terms of percentage speech samples rated natural out of total number of speech samples under three groups :

$$\text{Judge's Naturalness Rating} = \frac{\text{No. of samples rated natural}}{\text{Total No. of samples in group}} \times 100$$

Mean Naturalness Scores (MNS) were calculated from the percentage naturalness ratings given by five judges :

$$\text{Mean naturalness scores} = \frac{\text{Sum of naturalness ratings of judges}}{\text{No. of judges}}$$

T' test was done to find out the significance of difference between the means of the naturalness judgement for (1) reading and speech task (2) various parameters (3) normal, pre-therapy and post-therapy samples for both reading as well as for spontaneous speech task.

Pearson's correlation was calculated to find out the correlation between overall ratings and other parameters as well as for the relationship between mean naturalness score and percent dysfluency and rate of speech , and also , correlation between overall MNS and MNS for the parameter of rate

. A factor analysis was performed to find the parameters of importance for naturalness ratings for both tasks . Inter judge reliability was calculated using phi-coefficient and Spearman's rank correlation method was used to calculate intra -judge reliability.

CHAPTER IV

RESULTS AND DISCUSSION

RESULTS

I. PILOT STUDY

Mean Naturalness scores

The MNS obtained from the ratings of sophisticated and unsophisticated judges are shown in Table-3 .

	Sophisticated	Unsophisticated
Normal	Mean 3.08	3.55
	Range 1 to 4.5	2 to 5
Pre-therapy	Mean 5.52	4.97
	Range 2 to 8.33	1.67 to 8.66
Post-therapy	Mean 4.64	4.66
	Range 2 to 7.33	2 to 9

Table-3 : Mean naturalness scores

The mean naturalness score was lowest for the normal speech followed by the ratings for post-therapy speech samples and a highly unnatural rating for pre-therapy samples. However, the range of variability in both pre-therapy and post-therapy overlap and range from 8 / 9 to 1 / 2. The results of the "T" test indicated a significant difference between the MNS of sophisticated and unsophisticated judges at 0.05 level . Also the correlation was high within subjects (0.80, 0.77 and 0.87). Table-4 shows the rating by sophisticated judges.

	Normal		Pre-Therapy		Post-Therapy	
	1st Rating	Re-rating	1st Rating	Re-rating	1st Rating	Re-rating
S1	4	3.66	5.30	5.84	5.15	5.38
S2	2.33	2	7.15	6.53	5.69	6.15
S3	2.66	1.33	4.61	4.07	3.46	2.23

Table-4 : Rating by Sophisticated judges

Table-5 shows the MNS, percent dysfluency and rate of speech for all the subjects. The MNS is obtained for normal, pre-therapy and post-therapy samples by sophisticated and unsophisticated judges . Figure-1 has the graphical representation of MNS , percent dysfluency and rate of speech .

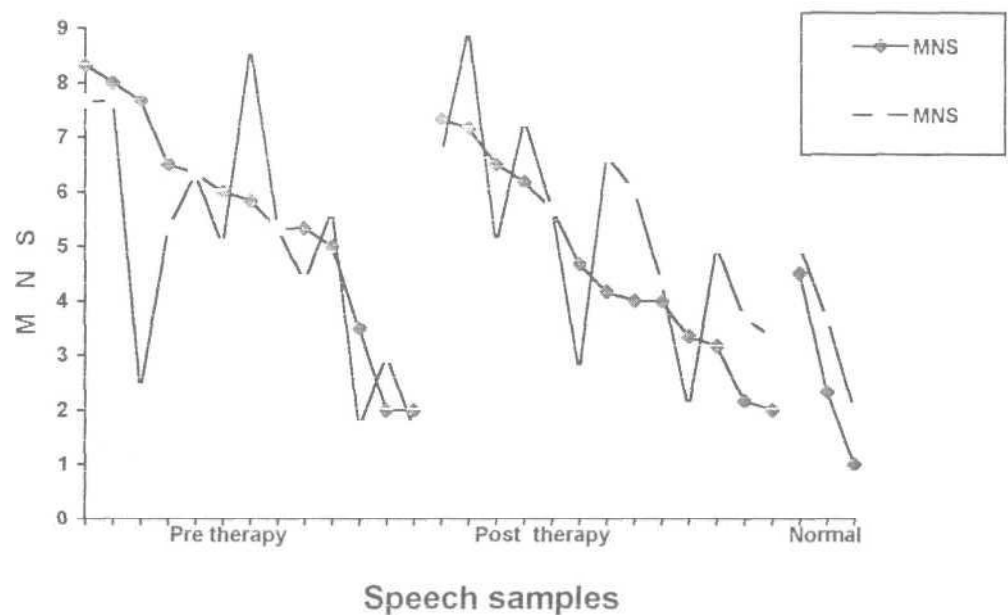


Figure - 1 : Mean Naturalness Scores of the Normal , Pre-therapy ,

Post-therapy speech samples .

Group	M N S (Soph .)	M N S (Unsoph .)	Percent dvsflucny	Rate of speech
Normal	4.50	5.00	0.00	61.30
	2.33	3.66	0.00	95.00
	1.00	2.00	0.00	96.92
Pre-therapy	8.33	7.66	43.40	45.00
	8.00	7.66	21.00	49.00
	7.67	2.33	29.00	68.00
	6.50	5.33	50.00	40.00
	6.33	6.33	19.00	50.00
	6.00	5.00	18.00	59.00
	5.83	8.66	19.00	50.00
	5.33	5.33	0.00	59.00
	5.33	4.33	12.00	68.00
	5.00	5.67	2.00	58.00
	3.50	1.67	3.00	74.00
	2.00	3.00	2.27	120.00
	2.00	1.67	2.27	120.00
Post-therap\	7.33	6.67	14.00	39.00
	7.16	9.00	0 00	45.00
	6.50	5.00	6.00	64.00
	6.17	7.34	0.00	83.00
	5.67	5.67	0.00	64.00
	4.67	2.67	3.35	67.12
	4 16	6.67	000	54.00
	4.00	6.00	0.00	70.00
	4.00	4.33	0.00	84.00
	3.34	2.00	0.00	84.00
	3.17	5.00	0.00	96.00
	2.17	3.67	0.00	68.00
	2.00	3.33	18.00	59.00

Table - 5 : MNS , Percent dysfluency and Rate of speech

Soph . = Sophisticated
Unsoph . = Unsophisticated

Table - 6 shows correlation between MNS and percentage dysfluency which indicates that in the pre-therapeutic samples MNS appears to be directly correlated with percent dysfluency i.e, increase with percent dysfluency. This

correlation is stronger for the sophisticated judges than the unsophisticated ones.

	Pre-therapy	Post-therapy
Sophisticated	0.71	0.01
Unsophisticated	0.29	-0.15

Table - 6 : Correlation between MNS and Percent dysfluency

Table- 7 indicates a negative correlation between MNS and rate of speech i.e., MNS decrease as the rate of speech increase. Also, the correlation was high for the normal and pre-therapy speech samples for the sophisticated listeners.

	Normal	Pre-therapy	Post-therapy
Sophisticated	-0.97	-0.84	-0.47
Unsophisticated .	-0.85	-0.72	-0.43

Table- 7 : Correlation between MNS and rate of speech

DISCUSSION

The results of this pilot study reveal several points of interest. First of all, there was a difference between the naturalness ratings of the post therapeutic, pre-therapeutic stutterers and the non-stuttering population , and the pre-therapy samples were rated as highly unnatural. This is consistent with the result of the other studies (Martin et al . , 1984; Ingham, Gow and Costello, 1985, Ingham et al 1989; Runyan, Bell and Prosek 1990). However the MNS difference between pre-therapy and post- therapy speech samples was not significant.

Second, there appeared to be significant difference between the MNS of sophisticated and unsophisticated judges . This is in contradiction to the results of Onslow et al., (1992) . The lack of awareness of the problems, treatment

options and outcomes in the area of stuttering may be an important factor in identifying the naturalness. Also to be considered is the definition of unsophisticated judges . While the present study included listeners totally unrelated to the field of Speech and Hearing, that of Onslow et al . , (1992) ; used first year under graduate students with atleast one course in Speech language pathology although without any exposure to stuttering per se.

Third, the MNS correlated with percent dysfluencies and rate of speech. In the pre-therapy samples , MNS directly correlated with percent dysfluencies i.e., MNS increased as percentage dysfluencies increased. However, the correlation between MNS and rate of speech was higher than that of MNS and percentage dysfluencies. While in the pre-therapy samples MNS and percent dysfluency had direct correlation, in the post-therapy samples MNS and rate of speech had negative correlation. In the pre-therapy samples judges appeared consider both percentage of dysfluencies and rate for rating and in the post-therapy sample only rate was considered. Also, with respect to the type of judges, the unsophisticated judges appeared not to consider the percentage dysfluencies and rate was a better parameter for them. In general, unsophisticated judges performed poorly compared to sophisticated judges .

The higher correlation in sophisticated judges may be because a sophisticated judges are more sensitive to and less tolerant to the dysfluencies when compared to the unsophisticated judges .

Fourth, intra-judge reliability was good . However , there were extreme variations in the individual ratings of each sample. Also, the judges found the task long and difficult , reducing their concentration and interest in the task. On the basis of MNS it is not possible to distinguish pre-therapy and post-therapy samples. Therefore it appears that a two-point naturalness scale may be more appropriate than an unstable 9-point scale.

II MAIN STUDY

Part I: Development of the naturalness scale

The results revealed that the parameters , confidence , command over language , clarity, speed , continuity and stammering were important in determining the naturalness of speech . The percentage weightage of these parameters are in table 8

Confidence	83%
Command over language	78.5 %
Clarity	65.3 %
speed	53 %
Continuity	39%
Stammering	35 %

Table 8 - Percentage weightage of various parameters

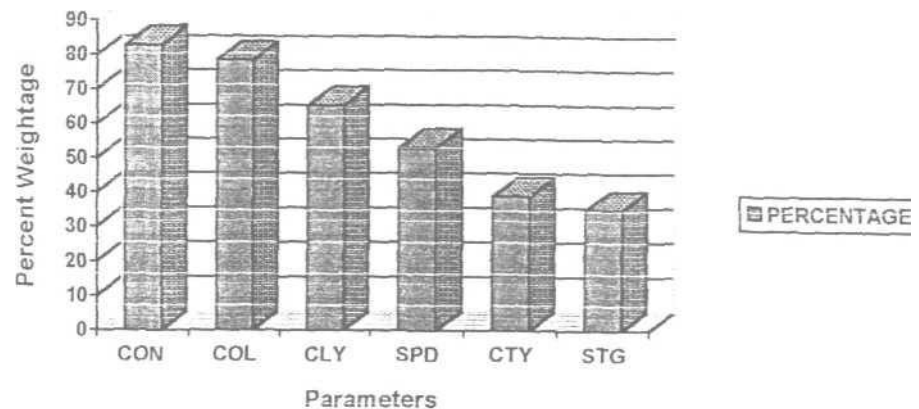


Fig - 2 : Percentage weightage of various parameters

CON - Confidence , COL - Command over language , CLY - Clarity .
 SPD - Speed , CTY - Continuity , STG - Stammering

Although pronunciation , breathing pattern , variation in pitch were mentioned, they did not receive a high weightage (> 20 %) and thus were not considered for further study . These parameters in the table on a binary choice of natural / unnatural, formed the naturalness scale .

Part II: Naturalness scores in stutterers

1) Mean Naturalness Scores (Henceforth MNS)

Table 9 shows MNS assigned for the reading and spontaneous speech tasks for the three groups viz . normals and stutterers before and after therapy . It was noticed that speech samples of normals received the highest score indicating naturalness . This was followed by the MNS of the samples of stutterers after therapy and before therapy . 'T' test did not reveal any significant difference (at .05 level) between the MNS of reading and

spontaneous speech samples . Also , a high correlation (pearson's) existed between the MNS of reading and spontaneous speech .

Category	M N S			
	Reading	Spontaneous speech	Pearson's r	Significant difference
Normal	76	85.5	.74	-
Post-therapy	51.5	51	.85	-
Pre-therapy	47.5	37	.63	-

Table 9 - MNS in Reading and Spontaneous speech tasks

(+) Indicates significant difference
 (-) Indicates no significant difference

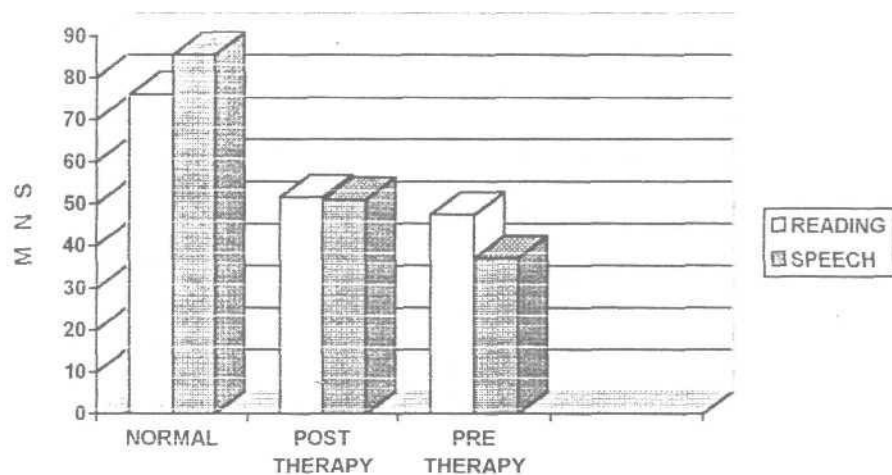


Fig - 3 : MNS in reading and spontaneous speech tasks

2) Mean Naturalness Scores as judged by normals and stutters .

'T' test did not show significant difference (.05 level) between the MNS of the two groups of judges viz . normals and stutters except for the ratings of the pre-therapy spontaneous speech samples . Hence , for the other statistical calculations , the two groups were considered as one set of listeners

Table 10 shows the significant difference between normals and stutters

Parameters	Reading	Speech
Normal	-	-
Pre-therapy	-	+
Post-therapy	-	-

Table 10 - Significant Difference between two groups of unsophisticated listeners

3) Mean Naturalness Scores for various parameters

Tables 11,12,13 and 14 indicate the MNS obtained for various parameters, Except for the parameter speed , the MNS for all other parameters between normals and stutters were significant (.05 level) in the spontaneous speech task . However, for the reading task , MNS of all parameters except confidence , command over language and speed were significantly different between normals and stutters .

While in normals , clarity was rated as highly natural and speed as least natural, in stutters it was not so . Amongst the latter, while clarity was rated as highly natural, continuity received least MNS scores in all conditions .

Parameters	M N S		Pearsons r	Significant difference
	Normal	Pre-therapy		
Confidence	78	37.5	.72	+
Command over language	75.5	57	.85	+
Clarity	90	66	.77	+
Speed	64	43.5	-.13	-
Continuity	68	16	.58	+
Stammering	71	21.5	.38	+
Overall	65.5	37	.69	+

Table 11 - MNS for Normal and Stutterers before therapy in speech

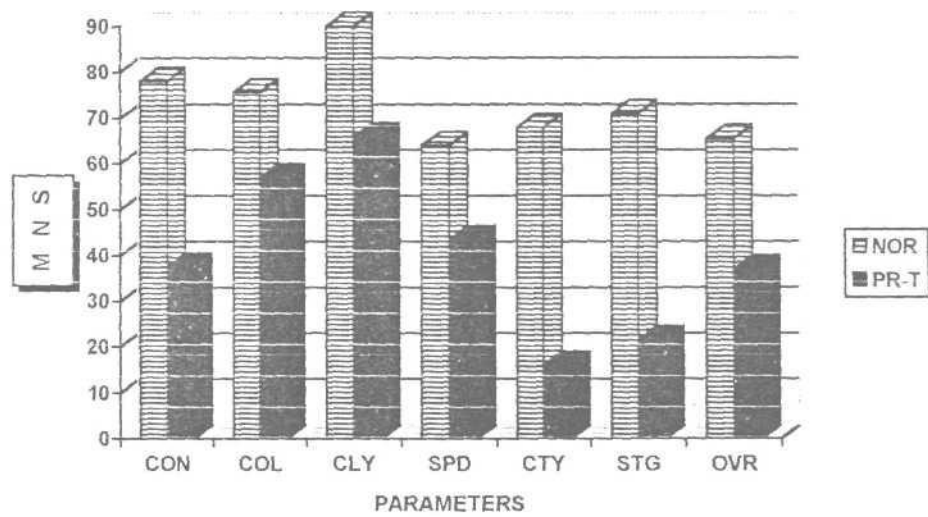


Fig - 4 : MNS for Normal and Stutterers before therapy in spontaneous speech

CON - Confidence , COL - Command over language , CL Y - Clarity ,
 SPD - Speed , CTY - Continuity, STG - Stammering , OVR - Overall

Parameters	M N S		Pearsons r	Significant difference
	Normal	Pre-therapy		
Confidence	68.5	45.5	.40	-
Command over language	85	64	.18	-
Clarity	92.5	66.5	.11	+
Speed	52.5	44.5	.55	-
Continuity	71	35	.46	+
Stammering	73.5	36.5	.65	+
Overall	76	47.5	.71	+

Table 12 - MNS for Normal and Stutterers before therapy in reading

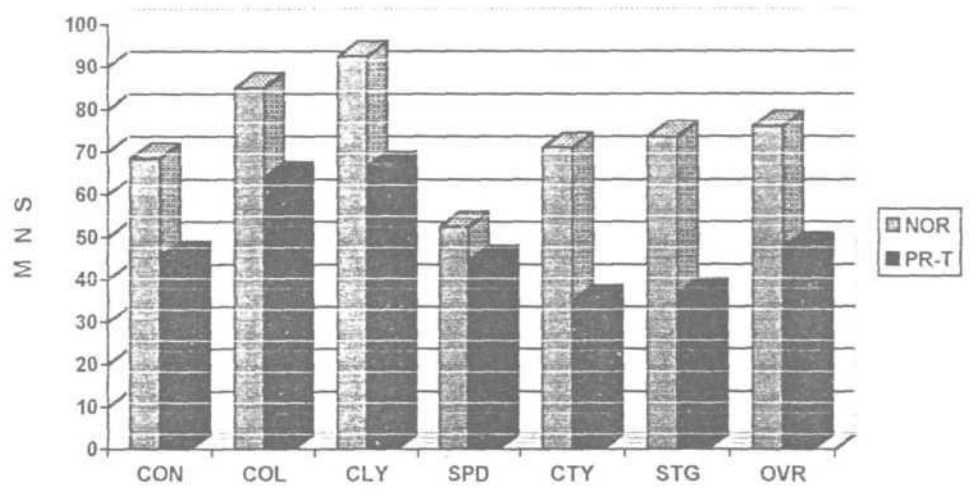


Fig - 5 : MNS for Normals and Stutterers before therapy in Reading

CON - Confidence , COL - Command over language , CLY - Clarity ,
 SPD - Speed , CTY - Continuity , STG - Stammering , OVR - Overall

Parameters	M N S		Pearsons r	Significant difference
	Normal	Post-therapy		
Confidence	75	45	.87	-
Command over language	71.5	59.5	.97	+
Clarity	90	78	.83	+
Speed	64	51	.02	-
Continuity	68	33.5	.61	+
Stammering	71	43	.26	+
Overall	65.5	51	.91	+

Table 13 - MNS for Normals and Stutterers after therapy in spontaneous speech

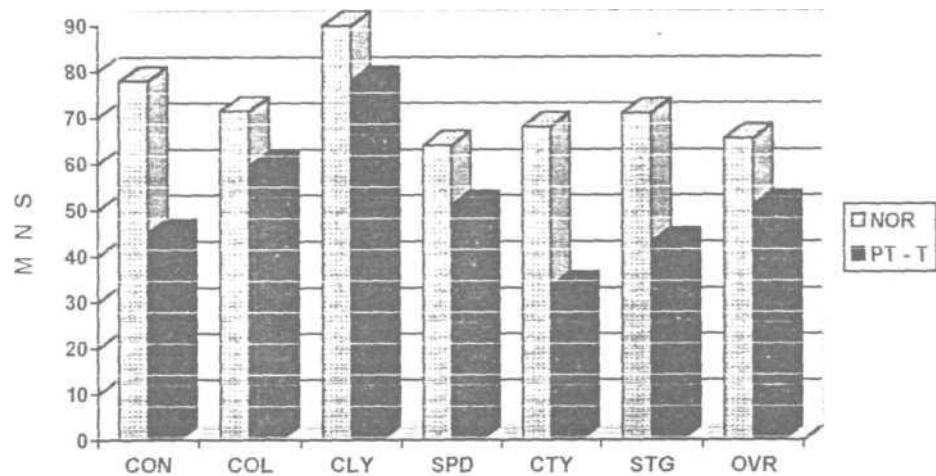


Fig - 6 : MNS for Normals and Stutterers after therapy in Spontaneous speech

CON - Confidence , COL - Command over language , CLY - Clarity,
SPD - Speed , CTY - Continuity , STG - Stammering , OVR - Overall

Parameters	M N S		Pearsons r	Significant difference
	Normal	Post-therapv		
Confidence	68.5	48.5	.23	-
Command over language	85	63	.41	-
Clarity	92.5	70	.27	+
Speed	52.5	55.5	.53	-
Continuity	71	40	.50	-
Stammering	73.5	51.5	.28	-
Overall	76	51.5		-

Table 14 - MNS for Normal and Stutteres after therapy in reading

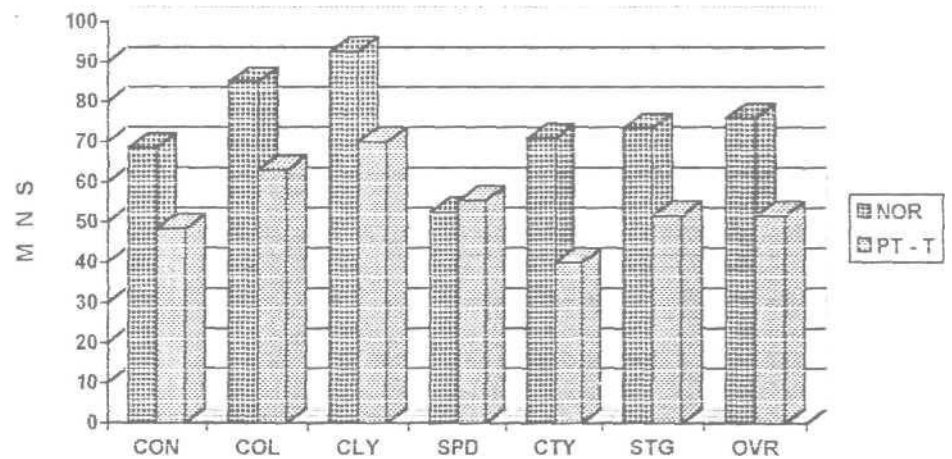


Fig - 7 : MNS for Normal and Stutterers after therapy for Reading

CON - Confidence , COL - Command over language , CLY - Clarity ,
SPD - Speed , CTY - Continuity , STG - Stammering , OVR - Overall

Table 15 and 16 shows MNS of pre-therapy and post-therapy for spontaneous speech and reading samples . It was observed that MNS was higher for post-therapy spontaneous speech and reading samples compared to the pre-therapy ones . However , significant differences were observed only between stammering and overall MNS (reading) and speed , continuity , stammering , overall and command over language (spontaneous speech) indicating that more parameters significantly differed in spontaneous speech than in reading .

Parameters	M N S		Pearsons r	Significant difference
	Pre-therapv	Post-therapv		
Confidence	37.5	45	.91	-
Command over language	57	59.5	.84	-
Clarity	66	78	.89	+
Speed	43.5	51	.84	-
Continuity	16	33.5	.78	+
Stammering	21.5	43	.63	+
Overall	37	51	.82	+

Table 15 - MNS of Pre-therapy and Post-therapy for speech

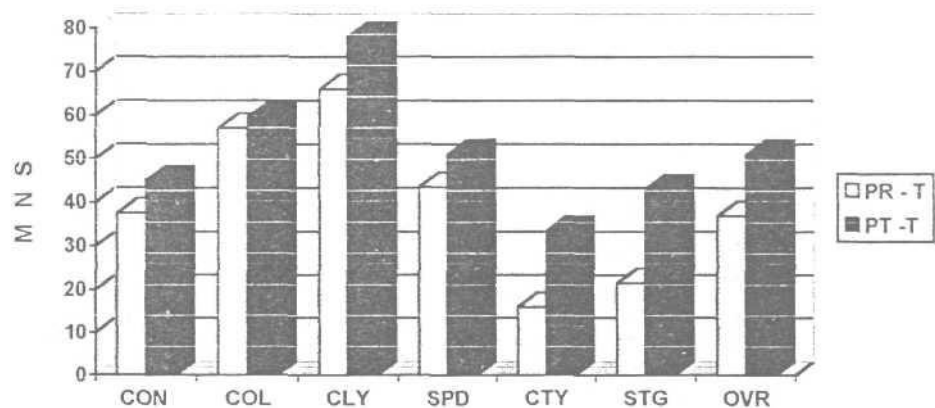


Fig - 8 : MNS of Pre-therapy and Post-therapy for Spontaneous speech

CON - Confidence , COL - Command over language , CLY - Clarity , SPD - Speed , CTY - Continuity , STG - Stammering , OVR - Overall

Parameters	M N S		Pearsons r	Significant difference
	Pre-therapv	Post-therapy		
Confidence	45.5	48.5	.95	-
Command over language	64	63	.97	-
Clarity	66.5	70	-.11	-
Speed	44.5	55.5	.65	-
Continuity	35	40	.92	-
Stammering	36.5	51.5	.85	+
Overall	47.5	51.5	.94	+

Table 16 - MNS of Pre-therapy and Post-therapy for reading

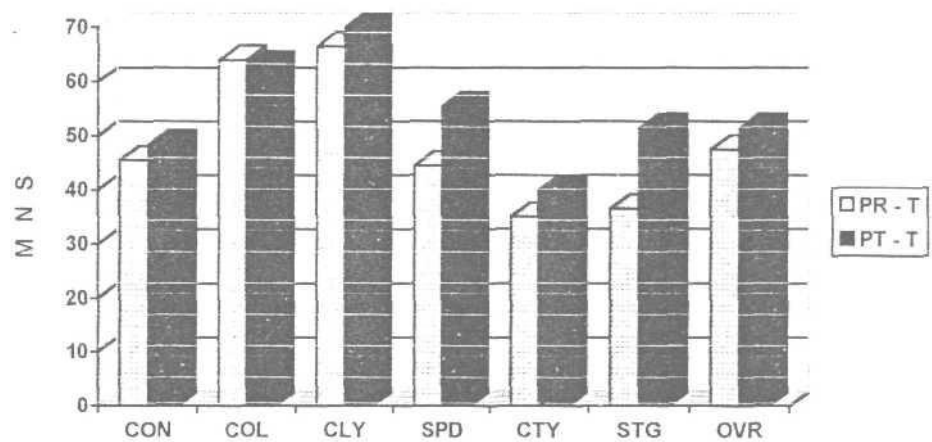


Fig - 9 : MNS of Pre-therapy and Post-therapy for Reading

CON - Confidence , COL - Command over language, CLY - Clarity ,
SPD - Speed, CTY - Continuity , STG - Stammering , OVR - Overall

4) Correlation between overall MNS and MNS of other parameters

Table 17 shows correlation between overall MNS and MNS of other parameters in normals . A high positive correlation existed between the overall MNS and continuity , confidence , and command over language (reading) and overall MNS and continuity and clarity (spontaneous speech) . Also , low correlation was observed between overall MNS and stammering and speed .

Parameters	Task	
	Reading	Speech
Confidence	.90	.10
Command over language	.80	.00
Clarity	.34	.87
Speed	.55	.24
Continuity	.97	.79
Stammering	.21	.00

Table 17 - Co-relation between overall MNS and MNS of other parameters in normals

In the samples of stutterers . for reading high positive correlation was observed between overall MNS and speed , continuity , clarity and command over language . However , in speech , this was observed only for continuity , speed and confidence This indicates that low MNS correlated with speed and continuity Table 18 and 19 indicate the correlations between overall MNS and MNS of other parameters in pre-therapy and post-therapy samples .

Parameters	Task	
	Reading	Speech
Confidence	.58	.71
Command over language	.73	.36
Clarity	.77	.36
Speed	.93	.38
Continuity	.85	.85
Stammering	.27	-.44

Table 18 - Correlation between overall MNS and MNS of other parameters in pre-therapy

Parameters	Task	
	Reading	Speech
Confidence	.60	.28
Command over language	.76	.24
Clarity	- .11	.41
Speed	.79	.73
Continuity	.81	.62
Stammering	-.20	.33

Table 19 - Correlation between overall MNS and MNS of other parameters in post-therapy

5) Other correlations

It was noticed that the overall MNS negatively correlated with percent dysfluency and positively with the number of words per minute uttered , indicating that the naturalness score increased as the percent dysfluency decreased and as WPM increased . Also , speed and WPM were positively correlated , although the correlation was not very high . Tables 20 and 21 show the correlations between MNS / Speed and percent dysfluency and WTM .

	Reading	Speech
Percent dysfluency	-.54	- .51
WTM	.45	.63

Table 20 - Correlation between overall MNS for percent dysfluency and WPM

	Reading	Speech
MNS for speed vs WPM	.29	.42

Table 21 - Correlation between MNS for speed and WPM

6) Factor patterns

In order to calculate the relative contribution of the various parameters, factor analysis was carried out . It was observed that factor 1 consisted of confidence , continuity, overall naturalness for all groups and factor 2 consisted of speed and stammering . This indicates that of all the parameters , command over language need not be considered for evaluating naturalness of speech .

Tables 22 and 23 provide the various factors and their loadings

Parameters	Normal		Post-therapv		Pre-therapv	
	Factor 1	Factor 2	Factor 1	Factor 2	Factor \	Factor 2
Confidence	.95	–	.93	–	.90	–
Command over language	-	-		.94	-	-
Clarify	–	–		–		–
Speed	–	.88	–	70	.71	–
Continuity	.87	–	88	–	.95	
Stammering	–	–	–	–	–	.96
Overall	.86	–	–	.80	.68	–

Table 22 - Factor loadings for reading task

Parameters	Normal		Post-therapy		Pre-therapv	
	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1	Factor 2
Confidence	–	–	.98	–	-	–
Command over language	-	-	-	-	-	-
Clarity-	.95	–	–	.94	-	.97
Speed	–	–	–	.90	–	.95
Continuity	.78	–	.81	–	.98	–
Stammering	–	.96	–	–	–	–
Overall	.97	-	-	-	.88	-

Table 23 - Factor loadings for speech task

7) Reliability

In order to calculate inter-judge reliability , Phi - coefficient was calculated . Table 24 shows the results obtained . A moderate degree of correlation was observed between the judges . However , in the reading task , judge S1 showed poor correlation .

	Reading						Speech					
	J1	J2	J3	S1	S2	S3	J1	J2	J3	S1	S2	S3
J1	-	.14	-.08	.00	.06	.55	-	.18	.38	.33	.41	.16
J2	.14	-	.66	.38	.55	.86	.18	-	.45	.46	.43	.37
J3	-.08	.66	-	.45	.45	.69	.38	.45	-	.33	.46	.32
S1	.00	.38	.45	-	.67	.64	.33	.46	.33	-	.61	.50
S2	.06	.55	.45	.67	-	.69	.41	.43	.46	.61	-	.65
S3	.55	.86	.69	.64	-	-	.16	.37	.32	.50	.65	-

Table 24- Phi - coefficient between judges

For intra judge correlation , rank correlation was calculated (Table 25). It was observed that the agreement between the ratings for all the judges was high for both the tasks .

	Speech	Reading
S1	.97	1
S2	.97	.97
S3	1	.97
J1	.94	.94
J2	.94	.97
J3	.97	.97

Table 25 - Intrajudge correlation

DISCUSSION

The study revealed a multitude of interesting facts that can be incorporated into the treatment paradigm of stutterers . Firstly , the parameters that a large group (60) post-graduate students, unrelated to the area of speech and hearing varied from the parameters considered important by speech and hearing graduates for speech naturalness . The results of the study by Kanchan (1997) revealed that the sophisticated listeners considered rate , stress , intonation , effort, continuity . articulation and breathing pattern as important parameters . However , the unsophisticated listeners or common man used confidence , command over language , clarity , speed , continuity and stammering to classify speech as natural or unnatural This finding has therapeutic value . As a speech language pathologist , the therapist tries to develop the former skills in the stutterers prior to discharge . However, in the out of clinic settings , the individual's speech is considered as natural using various other parameters . This suggests that the therapist should keep these parameters also in view during therapy and termination for higher success rates .

Second , no significant differences between the MNS of spontaneous speech and reading was noticed for all the three groups viz . normals , stutterers before and after therapy . This is in consonance with earlier literature . Onslow et al . , (1997) also found that there was no difference in the ratings for monologue and conversation .

Third , MNS decreased from normals to post-therapy samples to pre-therapy samples which is in consonance with the earlier research findings of Ingham et al . , (1982); Onslow et al . , (1982); Runyan et al . , (1990) and Onslow et al . , (1992).

Fourth , no significant differences between the ratings of the two sub-groups in the unsophisticated group of listeners i.e. , stutterers and nonstutterers was observed . The only exception was the pre-therapy samples in the spontaneous speech task . This may be attributed to the reduced tolerance of the stutterers towards the stuttering episodes when compared to the more tolerant 'layman' indicating that stutterers self rating of naturalness during therapy and for termination may serve as a useful parameter .

Fifth , significant difference between the MNS of all parameters except speed and clarity were observed between spontaneous speech samples of normals and stutterers (both pre and post therapy samples) . For reading , no significant difference were observed between the MNS of confidence , command over language and clarity . While dealing with stutterers in therapy , linguistic competence is beyond the realms of fluency therapy . However , counselling and systematic Desentization to increase confidence can be incorporated into therapeutic situations . The reasoning behind this is the significant difference seen in these parameters between normals and stutterers .

Also , the lack of difference between the parameters, confidence and command over language in reading task can be attributed to the fact that reading does

not require higher level motor programming and hence linguistic competence nor confidence can be judged in such a sample . This can also explain the fact that more significant difference between the MNS for more parameters were observed in spontaneous speech than in reading

Sixth , It appeared that a high correlation existed between overall MNS and confidence, command over language in normals and speed , continuity , clarity and command over language in stutterers This suggests that the rate of speech and continuity are important in determining speech as natural.

Seventh , MNS increased with increase in WPM and decrease in percent dysfluency . Fluency is defined as continuous , effortless flow of speech at a fast rate (Starkweather, 1980) As rate is one of the parameters contributing to fluency it contributes to the naturalness of speech .

Eighth , moderate degree of reliability was observed for both the reading and spontaneous speech tasks between the judges ratings . The rating of J_1 for spontaneous speech , however , was unreliable . The lower degree of reliability could be attributed to the heterogeneity of the judges used . However , it was observed that the intrajudge reliability was high . Similar results have been repeated by Martin et al . , (1984) ; Onslow et al . , (1990) where high degree of reliability , consistency and agreement was found between the judges

Finally , the factor analysis indicated that the first factor included confidence , continuity and overall MNS and the second factor included speed , clarity and stammering . The results of a similar study on sophisticated judges by Kanchan (1997) indicated that the factors were rate , continuity , effort and stress (for reading task) . It appears that command over language is not an important factor . Considering the results of both the studies , the naturalness can be rated by using the parameters rate , continuity , effort, stress and overall naturalness . The future studies may include these parameters as criteria to rate the naturalness of speech which could also be used for terminating the therapy.

The study has indicated that naturalness is rated differently by sophisticated and unsophisticated listeners . Although unsophisticated listeners are not familiar with the parameters of fluency , some of the parameters they have used are similar to these used by sophisticated listeners . The results indicate a need for including the parameters identified by the unsophisticated listeners in to the naturalness scale which can be used for monitoring therapy. It is also suggested that providing feedback to the stutterer during therapy regarding these aspects could improve naturalness of his speech, Also, quantification of some of the parameters like stress may improve the efficacy of the scale .

CHAPTER V

SUMMARY AND CONCLUSION

As a means of gauging the outcome of therapy, speech naturalness ratings of stutters' speech following therapy has gained importance over the years. The aim of the present study was to find out the parameters which, according to the unsophisticated listeners, contributed to speech naturalness and to investigate speech naturalness in the pre and post therapy samples of stutters as rated by unsophisticated listeners across these parameters.

A pilot study was carried out in which 29 spontaneous speech samples (including pre-therapy, post-therapy and normal speech) were rated by three sophisticated and three unsophisticated listeners on a 9 point scale. The results indicated that, although the MNS correlated with the percent dysfluency and words per minute, the scale was unable to discriminate between the pre-therapy, post-therapy and normal samples. Also, there was a difference in the way the sophisticated and unsophisticated judges rated the samples. On the basis of this, it was decided to use a binary scale to find out the parameters for naturalness. In the first part of the study, questionnaires were provided to 80 unsophisticated listeners to determine the parameters that they considered as contributing to naturalness. Analysis of the questionnaires indicated that the parameters confidence, command over language, clarity, speed, continuity and stammering were considered as contributing to naturalness which were the parameters considered for the second part of the study.

Four audio cassettes were prepared in which 68 spontaneous speech and reading samples consisting of natural , pre-therapy and post-therapy reading and spontaneous speech samples of stutterers were randomised and recorded . Also, seven samples were repeated randomly to test for reliability Six judges (three unsophisticated listeners and three stutterers) rated the samples on a binary scale (0 - natural , 1 - unnatural) based on the parameters. T - test was used to find out the significant differences between Mean Naturalness Scores of normals , and stutterers (before and after therapy.) Also , correlations were calculated .

The results indicated that the unsophisticated listeners were able to differentiate between the pre-therapy , post-therapy and normal samples for reading and spontaneous speech ie. the pre-therapy samples were rated as most unnatural , post therapy as unnatural and normal samples as natural for both the samples As a group , there was no significant differences in the ratings of the stutterers and the unsophisticated listeners .

With the exception of speed , all the parameters varied significantly between stutterers and normals . In the reading task , confidence and command over language did not show significant differences . In correlation with overall rating , it was found that the rate of speech and continuity were important factors . A factor analysis indicated that the factors that were important for rating naturalness were confidence , continuity , overall MNS, speed, clarity and stammering . Command over language was not a significant factor. Also,

a moderate degree of inter judge reliability and high intrajudge reliability was found .

The results indicate that the unsophisticated listeners used some parameters similar to the sophisticated listeners (Kanchan , 1997) such as continuity and speed . In the therapy situation , the termination depends upon the assessments of the therapist, who is a sophisticated listener . However , the stutterer as a speaker , has to face the society where he has unsophisticated listeners . Thus , the parameters identified for speech naturalness by unsophisticated listeners could be considered while determining the efficacy of therapy and terminating the therapy . Based on this study and the findings obtained , the following vistas of future research are available.

- 1) Detailed analysis of each of the parameters specified for the weight age in speech naturalness could be performed .
- 2) Stutterers self rating can be carried out in greater detail for perception of "how their speech sounds" .
- 3) Larger number of judges (homogenous or heterogenous) could be used to check for population variability .
- 4) Specific naturalness scales can be developed and standardised .
- 5) The naturalness ratings could be used in clinical / therapeutic situations to measure improvement.
- 6) The variation in speech naturalness on providing feedback could be a useful measure . This feedback can be specific and / or non-specific .

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APPENDIX - A
(Used in pilot study)

SPEECH NATURALNESS RATING

RESPONSE SHEET

INSTRUCTIONS: We are studying what makes speech sound natural or unnatural. You will hear a number of speech samples. The samples will be separated by a few seconds of silence. Each sample will be introduced by the sample number. Your task is to rate the naturalness of each speech sample. If the speech sample sounds highly natural to you, circle the 1 on the scale. If the sample sounds highly unnatural, circle the 9 on the scale. If the sample sounds somewhere between highly natural and highly unnatural, circle the appropriate number on the scale. Do not hesitate to use the ends of the scale (1 or 9) when appropriate. "Naturalness" will not be defined for you. Make your rating based on how natural or unnatural the speech sounds to you.

Task:

Sample No.	RATING SCALE VALUE								
	(Highly Natural)								(Highly unnatural)
38	1	2	3	4	5	6	7	8	9
39	1	2	3	4	5	6	7	8	9
40	1	2	3	4	5	6	7	8	9
41	1	2	3	4	5	6	7	8	9
42	1	2	3	4	5	6	7	8	9
43	1	2	3	4	5	6	7	8	9
44	1	2	3	4	5	6	7	8	9
45	1	2	3	4	5	6	7	8	9
46	1	2	3	4	5	6	7	8	9
47	1	2	3	4	5	6	7	8	9
48	1	2	3	4	5	6	7	8	9
49	1	2	3	4	5	6	7	8	9
50	1	2	3	4	5	6	7	8	9
51	1	2	3	4	5	6	7	8	9
52	1	2	3	4	5	6	7	8	9

Sample No.	RATING SCALE VALUE								
	(Highly natural)								(Highly unnatural)
53	1	2	3	4	5	6	7	8	9
54	1	2	3	4	5	6	7	8	9
55	1	2	3	4	5	6	7	8	9
56	1	2	3	4	5	6	7	8	9
57	1	2	3	4	5	6	/	8	9
58	1	2	3	4	5	6	7	8	9
59	1	2	3	4	5	6	7	8	9
60	1	2	3	4	5	6	7	8	9
61	1	2	3	4	5	6	7	8	9
62	1	2	3	4	5	6	7	8	9
63	1	2	3	4	5	6	7	8	9
64	1	2	3	4	5	6	7	8	9
65	1	2	3	4	5	6	7	8	9
66	1	2	3	4	5	6	7	8	9
67	1	2	3	4	5	6	7	8	9
63	1	2	3	4	5	6	7	8	9
69	1	2	3	4	5	6	7	8	9
70	1	2	3	4	5	6	7	8	9

Name::

Age/Sex:

Occupation:

Date:

APPENDIX - B

INSTRUCTIONS :

Describe the parameters which you think are responsible for the naturalness and unnaturalness of speech (especially fluency).

NATURAL	UNNATURAL

NAME :

AGE / SEX :

OCCUPATION :

APPENDIX - C

SPEECH NATURALNESS RATINGS

Instructions

Rate the speech samples provided to you on audio-cassettes, based on the following dimensions as natural or unnatural. Assign the value of 1 for natural and 0 if it is unnatural under different parameters listed for each sample. There are 68 speech samples, serially arranged at an interval of 10 sec. between them. Rate the naturalness of each speech sample on the response sheet provided to you.

Naturalness and Unnaturalness criteria for various parameters are listed below:

Sl. No.	Parameter	Natural	Unnatural
1.	Confidence and command over language	Speaks confidently with a good knowledge of language	Sounds Underconfident (maybe anxious or nervous) with poor usage of language.
2.	Clarity	Clear and easy to understand.	Not clear and difficult to understand
3.	Speed	Normal Speed	Too fast/too slow
4.	Continuity and Stammering	Continuous free flow of speech without any unnecessary pauses, breaks or repetitions	Does not flow freely and continuously. It is broken by unnecessary pauses or repetitions

Thank you for your time and kind co-operation.

