

# SOME ACOUSTIC CORRELATES OF STUTTERING: A PRE-POST THERAPY COMPARISON

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## ABSTRACT

*This study aimed at evaluating the efficacy of prolongation therapy in establishing fluency by measuring acoustic parameters in the pre post therapy samples of persons who stutter. Five persons who stutter (4 males and 1 female) in the age group of 12 to 25 years participated in the experiment. For spectrographic analyses, words in the pretherapy reading/ speech samples on which stuttering occurred and the same words in the post therapy samples were used. Results indicated several articulatory, laryngeal and aerodynamic disco-ordinations. The data supports the notion that stuttering is a disorder of disco-ordination in articulation, phonation and breathing.*

## INTRODUCTION

Stuttering has been considered as a disorder of disco-ordination in articulation, phonation and breathing (1). Van Riper (2), defines stuttering as a temporal disruption of the simultaneous and successive programming of muscular movements required to produce a speech sound or its link to the next sound. These beliefs are motivated by a number of studies in which timing and spatial errors are reported. The spatial errors reported in the speech of persons who stutter are inappropriate articulatory placement, (2,3,4) static articulatory positions (5,6), spatially restricted movements (4,7), forceful articulation (8), lower articulatory velocities (4,9), reverse muscular movements (10) and difficulty in stabilizing the articulatory movements (11). Inappropriate laryngeal gestures have also been reported (12,13,14,15). Other errors reported are missing or atypical formant transitions in the fluent and dysfluent speech of persons who stutter (16,17,18,19), and abnormal formant transitions (3,9, 20,21).

Symptomatically, several therapeutic methods have been proposed to achieve fluency. Programmes for treatment of stuttering frequently effect changes in the overall speech pattern, resulting in a situation where successfully treated persons who stutter are relatively fluent but their phonemes are slow, paced or monotonous and can be discriminated from the speech of non- persons who stutter (22). It is evident from both perceptual (22,23,24,25) and acoustic studies (24,26,27) that certain acoustic properties of the stuturer's fluent speech are altered by certain stuttering therapy. Most of these studies address the changes either in the perceptual or the acoustic parameters in the speech of persons who stutter. When the evaluation is carried out with the intention to improve therapy practice, elaborate descriptions of the speech before and after therapy are necessary. In this context, the present study was planned. The aim of the study was to evaluate the efficacy of prolongation therapy in establishing fluency by measuring some acoustic parameters in the pre and post therapy samples of persons who stutter. It was hypothesised that prolongation therapy will bring about changes in the acoustic aspects in persons who stutter.

## METHOD

**Subjects:** Five persons who stutter (4 males and 1 female) as diagnosed by Speech Pathologists at the diagnostic clinic of the All India Institute of Speech and Hearing, Manasagangothri, Mysore, were the subjects. Their age ranged from 12 years to 25 years with an average age of 19.4 years. All the subjects attended prolonged speech therapy consisting of the following: - (a) prolongation of syllables, smooth transitions between syllables, gentle voice onset (b) increase in speech rate (not systematically programmed) (c) monitoring of stuttering by the therapist and the client (d) transfer and maintenance. The number of sessions of therapy varied from 26- 90 hours.

**Procedure:** The subjects were seated comfortably and were tested individually. They were instructed to read the standard passage and to speak about their studies/work, which were audio-recorded. The same samples were recorded after therapy. The pre therapy sample was listened to and the words stuttered were identified. Wide band (300 Hz) bar type of Spectrograms of the stuttered words in the pre therapy reading sample/ speech sample and the same words in the post therapy reading/speech sample were obtained by feeding the

data to the DSP Sona-Graph Model 5500. From the Spectrograms, terminal frequency of F2 of the preceding or the following vowel, direction of movement of F2, Voicing: - present, absent, partially voiced and discontinuous: - were measured/ observed. T-test was used to find out the significant difference between the pre and post therapy evaluations. For reliability, all the measurements were repeated for the second time by the author, after six months of the first measurement.

## RESULTS

The results indicated no significant difference between the terminal frequencies of the pre and post therapy samples. However, the mean terminal frequency in the post therapy sample (326 Hz) was higher than that of the pre therapy sample (283 Hz). Table 1 shows the various features observed on the spectrograms, which are classified under articulatory, laryngeal and respiratory disco-ordinations. These were compared with the standard pattern of articulation by the native speakers of the language.

<b>Articulatory disco-ordinations</b>							
1.	Frication/frication before trill	4					- -
		57					
2.	Atypical transition	2	1	4	1	3	- -
		33	5	40	13	75	
3.	Missing F2 transition	5					- -
		35					
4.	Error in place and manner of articulation (c / t)	2					- -
		12					
5.	Dental clicks before trill			2			- -
				20			
6.	Nasal for nonnasal (m/d, m/b)			1	1		- -
				10	13		
7.	Omission of nasal continuant			2			- -
				25			
<b>Laryngeal disco-ordinations</b>							
1.	Half-voiced, murmur for voiced stops	2					5 -
		12					55
2.	Absence of voicing	6					2 -
		35					18
3.	Voiced for unvoiced stops			1			- 1
				13			100
<b>Aerodynamic disco-ordinations</b>							
1.	Audible inspiratory frication	2					- -
		20					
2.	Aspiration for unaspirated	1	3	1	2		-
		10	37	25	18		
<b>Total</b>		<b>6</b>	<b>16</b>	<b>10</b>	<b>8</b>	<b>4</b>	<b>9 1</b>

Table1: Disco-ordinations during stuttering. Numbers in line 1 indicate the number of disco-ordinations and those in line 2 indicate percent dis-co-ordinations.

The articulatory dis-co-ordinations included atypical/missing F2 transitions, errors in place and manner of articulations, production of nasal for nonnasals and vice-versa. Three types of laryngeal dis-co-ordinations were identified (a) usage of murmur instead of voicing which was indicated by voice bars superimposed by aspiration (b) absence of voicing in voiced sounds and (c) usage of voicing for unvoiced consonants as indicated by the presence of voice bars for unvoiced consonants. Aspiration was used for unaspirated stops, which was evidenced by the presence of low frequency noise. The word initial unaspirated stop /p/ was uttered as aspirated /ph/. Inspiratory frications were audible and were identified as fills on the spectrogram. Both these were classified as aerodynamic disco-ordinations.

Not all types of dis-co-ordinations were noticed in all stutterers, indicating a possibility of sub grouping of stutterers. No articulatory dis-co-ordinations were observed in the post therapy sample of any stutterer. It appears that the prolongation therapy was successful in eliminating articulatory dis-co-ordinations and not the laryngeal or the aerodynamic. It is possible that these dis-co-ordinations may be difficult to be eliminated or the prolongation therapy was not efficient in eliminating these or the training was insufficient. Subject 2, who did not show aerodynamic dis-co-ordinations in the pre-therapy samples, used aspiration for unaspirated stops and murmur/ absence of voicing for voiced sounds. The incomplete closure of the vocal folds for the voiced sounds (murmur) and the opening of the vocal folds (absence of voicing) indicates difficulty in adjusting the laryngeal gestures.

The hypothesis that prolongation therapy will bring about changes in the acoustic features in the speech of stutterers was accepted in that, the dis-co-ordinations decreased following therapy. However, no one-to-one correlation could be established between the prolongation therapy and the changes in perceptual and acoustic features. Though S2 and S4 showed less number of dysfluencies, which lead to the consideration of their speech as normal, acoustically they still exhibited some abnormal features. It appears that speakers use prolongation therapy to eliminate various abnormal characteristics. However, as only five subjects were considered in the study, it is not possible to generalise the results. Research involving more number of subjects may throw light on this area.

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