

# Articulatory Dynamics of Stutterers

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The present study was aimed at acoustically analyzing the articulatory dynamics in four stutterers to obtain a wholistic and conclusive observation on articulatory dynamics in stutterers.

Four adult male stutterers as diagnosed by a Speech Pathologist were selected for this study. The age range of the four stutterers was 20-30 years. The subjects were instructed to speak/read into the microphone (cardioid, unidirectional) and these utterances were audio-recorded on a high fidelity magtic 7 1/2" tape using the internal taperecorder of the sound spectrograph VII 700. The speech and reading samples were listened to and the perceptually dysfluent and their counterpart fluent utterances (if any) were selected. Wide band bar type of spectrograms were obtained for all these utterances. Using the wide band bar type spectrograms, measurements of five temporal parameters for both dysfluent and fluent utterances were made. These parameters were - phoneme duration, voice onset time aspiration duration, transition duration of F2 of the following vowel and speed of transition of F2. The five temporal measures of dysfluent and fluent utterances were compared. Analysis of variance (ANOVA) was applied to find out the significant difference between the fluent and dysfluent utterances. Descriptive analysis was also performed to delineate the results.

Based on the descriptive and inferential statistical analysis, twelve kinds of articulatory errors were identified. These were as follows :

1. **Errors of aspiration** : Wherein the initial subsegment of the dysfluent utterances were aspirated. The mean aspiration duration was 186.5 msec. The aspiration error in stutterers utterances could be attributed to high subglottic pressure and inappropriate glottal gesture, causing air to pass through glottis.
2. **Errors of Coarticulation** : CV formant transition errors were observed in both initial and medial segment of stuttered words. Four kinds of coarticulatory errors were noticed
  - a. **Lack of formant transition** : The spectrograms of some dysfluent utterance were characterized by the absence of formant transition. This indicates that a stutterer is unable to transit or move from one phoneme to another.
  - b. **Longer transition duration** : The transition duration of F2 was longer for dysfluent utterances than the corresponding fluent utterance. This implies that the time lapse between the movement of articulator from one target to another is long.
  - c. **Shorter transition duration** : Some dysfluent utterances were characterized by shorter transition duration of F2 than the corresponding fluent utterance. This indicates shorter time lapse between the movement of articulators from one target to another.
  - d. **Inappropriate transition** : Inappropriate formant transition were observed in two dysfluent utterances. This indicates that the articulator mistargeted the production of the following vowel

- 3. Addition or interjection** : Interjections like "urn", "a" and phonemes like /s/ were added in between the words which would be either a placement error or an addition.
- 4. Errors in manner of articulation** : All the four subjects had errors in manner of articulation . This included errors such as devoicing the initial subsegment of dysfluent word, substitution of stops for fricatives, substitution of stops for nasals and substitution of stops for vowels. These results indicates inappropriate articulatory gestures, forceful articulatory patterns and excessive muscular activity in stutterers.
- 5. Errors in place of articulation** : Errors in place of articulation like substitution of dental stop for bilabial stop, substitution of dental stop for the vowel were observed in certain utterances.
- 6. Prolongation** : All the four stutterers prolonged the initial phoneme of the dysfluent word. The mean phoneme duration of the dysfluent utterance was found to be significantly longer than the phoneme duration of fluent utterance.
- 7. Error in coordination of articulatory and glottal gesture**: The coordination between articulatory and glottal gesture is indicated by voice onset time. The voice onset time of the initial segment of dysfluent and the corresponding fluent utterances was measured and compared. The mean voice onset time of fluent utterance was greater than that of

dysfluent utterance. However, there was no significant difference between them.

Apart from the above, combination of two errors were also found. This included :

6. Errors of place and manner of articulation.
7. Prolongation.
8. Errors of aspiration and coarticulation.
9. Errors of coarticulation and place of articulation
10. Errors of coarticulation and prolongation.
11. Errors of coarticulation and manner of articulation.

The results thus reveal that stutterers exhibit several articulatory abnormalities which emphasize the notion that stuttering is an articulatory disorder. The cause of the disorder is speculated to be in some unknown higher centre of the nervous system. The Sequencing the Timing model by Mackay (1982) seems to explain the occurrence of dysfluencies in stutterers. The analysis of errors indicate individual differences observed in the occurrence of dysfluencies. Each of the four stutterers studied had some characteristic dysfluencies. This suggests that stutterers can be classified based on the errors obtained from the acoustic analysis provided a sufficiently large sample is used. The results also indicate some diagnostic and therapeutic implications. Acoustic analysis seems to be sensitive in detecting the articulatory abnormalities in dysfluent productions and could be employed in the assessment of stuttering. This warrants the clinician to design specific fluency enhancing techniques to eliminate the external symptoms.