A DISTINCTIVE FEATURE ANALYSIS OF STUTTERED PHONEMES

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Stuttered sounds and syllables often have been analyzed in an attempt to determine what aspects of them cause difficulty for the stutterer. Early researchers studied the phonetic content of words and discovered that consonants appeared to be stuttered more often by adults (Brown, 1938; Hahn, 1942; Quarrington, Conway, and Siegel, 1962). More recently, Wingate (1969:677-86) has suggested that the way stutterers phonate may affect their fluency. This raises the possibility that the voicing feature might be present more frequently in stuttered phonemes than in nonstuttered phonemes.

Adams and Reis (1971:639-44; 1974:752-54) have suggested that the stutterer's inability to coordinate respiratory, phonatory, and articulatory systems for "off/on" voicing adjustments precipitates dysfluency. This implies that chances of stuttering may increase when a (- voice)/(+ voice) feature combination is present. Support for this contention that the vocalization process is a main factor in stuttering was provided in a study by Brenner, Perkins, and Soderberg (1972:483-86).

Employing spectrographic analysis, Agnello (1974:40-67) determined that stutterers display significantly longer transition times for both voice onset (VOT) and voice termination times (VTT) than did nonstutterers. Additionally, stutterers were "slower in initiating the voice during the opening phase of consonant release (VOT) or slower in approaching the closure (VTT) phase." Results of a later study by Adams and Hayden (1976:290-96), using oscillographic measures, support Agnello's findings.

Shapiro (1980:203-31), using electromyographic data, discovered that dysfluency is related to poor coordination of normally reciprocally functioning muscles. For example, two muscles that typically function reciprocally were observed to be co-contracting beginning at the same millisecond. Further, stutterers showed a high degree of variability relative to which muscles were functioning aberrantly while maintaining the primary site of tension, whether at lingual, labial, or laryngeal levels. Results of Shapiro's work suggest that the site of primary tension varies

from utterance to utterance, implying that more than merely the (- voice)/(+ voice) feature combination might be present significantly more frequently in stuttered than in nonstuttered phonemes.

This study was designed to determine the contribution that voicing and other production processes make to stuttering in the elicited spontaneous speech of adult stutterers, ages 18 to 50 by measuring the effect of phonetic content on stuttering. The Chomsky and Halle distinctive feature definitions (1968:302-29) were used to analyze the data in this study.

Although a distinctive feature system does not completely describe the processes involved in connected speech, it is a viable means to compare stuttered and nonstuttered phonemes. The system provides a standardized method of describing the processes that are operative while articulating speech.

The sample for analysis was limited to adult stutterers to ensure that each subject's speech be characterized by "fully-developed" stuttering. Children were excluded from the sample also because the relationship of stuttering to some linguistic variables may be somewhat different for adults than for children who stutter. For example, Wall (1978) found that the children in his study stuttered more on initial vowels than on initial consonants, as do adult stutterers.

Method

The subjects in this study consisted of twenty males, ages 18 through 50, with moderate to very severe stuttering, who had completed at least one year of college or who were attending college at the time of the study. This investigation was limited to male subjects in view of the possibility that stuttering may not be the same phenomenon in females as in males (St. Onge, 1972: 29-33). The stipulation of college attendance assured intelligence within normal limits, eliminating mental retardation, which has been known to affect speech performance as a variable.

To ensure uniformity of severity ratings, three judges, the author and two other speech pathologists, employing the Riley Stuttering Severity Instrument (Riley, 1972:314-21), determined

the degree of severity for each subject. Of the twenty subjects, seven were judged to have "moderate" stuttering; six were judged to have "moderate to severe" stuttering; five had severe stuttering; and two were placed in the category of "very severe" stuttering. The three judges agreed on all of these ratings.

The equipment included one General Electric cassette tape recorder (Model 704), twenty cassette cartridges, and five cards from the Thematic Apperception Test (TAT). The use of audio tape recordings was based on the work of Williams, Wark, and Minifie (1963:91-100), who found that audible cues alone are sufficient for obtaining useful and reliable measures of the frequency and the severity of stuttering.

The TAT cards were shown to each subject individually in a small room, relatively free from noise and distractions. Each subject was seated at a small table, facing the examiner. The entire session was tape recorded. The examiner, the author of the study, remained the same for all subjects. In accordance with recommendations from similar research, no observers other than the examiner were in the room when the tape recordings were made (Johnson, Darley, and Spriestersbach, 1963).

The instructions were derived from the directions accompanying the TAT test (Murray, 1943). The subjects composed a narrative for each TAT card presented. The pictures were presented in the same order for each subject. The examiner allowed each subject one minute to prepare his narrative while he studied the TAT card. The same instructions and procedure were maintained for each subject.

The transcripts were analyzed with the Chomsky and Halle feature system after the stuttered phonemes were determined by the author. Stuttering was defined as repetitions of initial sounds or syllables and prolongations of initial sounds. A reliability check was obtained at .98 agreement with another speech pathologist.

The total number of stuttered phonemes at the beginning of sentences was computed for each subject and an equal number of non-stuttered initial phonemes was derived in the following way. The total number of utterances in each transcript was divided by the

total number of stuttering instances. Every utterance that was a multiple of the resulting quotient was then extracted. The initial word then was selected from each of those lines while the first sound of the selected word was then extracted for analysis.

The number of times that each phoneme occurred in initial position was computed for both stuttered and nonstuttered speech. From this information, the frequency of each feature in the initial phoneme was determined.

Results and Discussion

The stuttered frequency and nonstuttered frequency for each feature in initial phoneme selected were compared with the t test for related measures. The features (+ consonantal), (- voice), (+ continuant), and (- strident) occurred significantly more often in the initial position of stuttering instances than in the initial position of nonstuttered instances. (See Table 1).

TABLE 1

Results of t tests

Feature	t Score	Significance
+ consonantal	5.89	.001
- voice	2.43	.05
+ continuant	2.09	.05
- strident	5.30	.001

The feature (+ consonantal) occurred significantly more often in the initial stuttered phonemes, supporting the earlier observations that adult stutterers tend to stutter more frequently on consonants than on vowels. In addition, the second phoneme in the instance of stuttering was checked and found to contain the feature (+ vocalic) significantly more often. Consonant/vowel combinations (CV syllables) were stuttered more frequently than were vowel/consonant combinations (VC syllables).

The (- voice) feature was observed to occur significantly more frequently in stuttered phonemes than in nonstuttered phonemes, supporting Adams and Reis' hypohesis (1971:639-44; 1974:752-54) that predicts that stuttered words should begin with a voiceless sound more often than with a voiced one, even though the sounds that are voiceless occur less often in the language than those that are voiced. The findings of this study imply that chances of stuttering increase when a (- voice)/(+ voice) combination is present. These results support Agnello's findings of stutterers' delay in initiating and terminating phonation.

Other features that occurred significantly more frequently in the stuttered phonemes than in the nonstuttered phonemes were (+ continuant) and (- strident). The (+ continuant) feature is contained in sounds in which a partial obstruction to air flow is present in the vocal tract. These sounds include /l/, /r/, /f/, /v/, /θ/, /ð/, /s/,/z/, /ʃ/, /ʒ/, and /h/. Of these sounds, the ones which also contain the feature (- strident) include /l/, /r/, /θ/, /ð/, and /h/, which are characterized by a lack of noisiness produced when air passes over a rough surface at the appropriate rate of flow and angle of incidence, as Chomsky and Halle suggest.

This data suggests that stuttering is more likely to occur when the primary sites of tension are lingual and laryngeal combined and when the laryngeal muscles must also shift from (- voice) to (+ voice). Poor coordination of normally reciprocally functioning muscles involved in phonation and articulation (Shapiro, 1980) may result in the predominence of the features (+ consonantal), (- voice), (+ continuant), and (- strident) in the initial phonemes on which adults most frequently stutter.

Future research should focus on continued physiological, acoustic, and perceptual studies of adult stuttered speech during coarticulation. A distinctive feature analysis of stuttered phonemes of children should be conducted to determine if syntactic and semantic as well as phonological factors may influence the phonetic content of speech of children in ways that differ from their influence on adult speech.

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