Voice Onset Abruptness in Stutterers 
Before and After Therapy 

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In most research and clinical work on stuttering, recognition of stuttered speech is accomplished directly by an observer or observers. The observer is the instrument for identifying and quantifying characteristics of stuttered speech. Specific interests and perceptual skills of investigators determine the level of resolution attained in observation. Typically, resolution has ranged from global ratings of stuttering severity (Johnson, Darley and Spriestersbach, 1963), to frequency counts of a few particular types of disfluency (Williams, Darley and Spriestersbach, 1978) to more "molecular" levels in which numerous disfluency types are elaborated (L.M. Webster and Brutten, 1972). In spite of the diversity of events examined by different investigators, it seems clear that the focal features of stuttered speech involve aberrant properties of speech muscle activity, many of which are simply not readily available for direct, unaided human observation.

In the investigation of stuttering, as in other areas of science, descriptions of events improve and discoveries multiply as tools are developed that extend the resolution of observation and permit better quantification of what is being observed. Improved descriptions of aberrant motor activities during stuttered speech are now appearing.

Laryngeal activity during stuttering has been observed recently via several methods. Conture, McCall and Brewer (1977) used the fiberoptic endoscope to visualize and record behaviors of the larynx during stuttered speech. These investigators reported that at times during speech the larynx was inappropriately and unpredictably open and that at other times it was inappropriately closed. It was indicated that different types of disfluency were associated
with different forms of laryngeal activity. Part-word repetitions were generally associated with abductory laryngeal activity during the time course of the perceived disfluencies while sound prolongations were generally associated with adductory laryngeal activity.

EMG measurements of intrinsic muscle activity were made with hooked wire electrodes during stuttered and fluent speech by Freeman (1977), Freeman and Ushijima (1978), and Shapiro (1980). The general findings were that stuttered speech was associated with higher levels of muscle activity than fluent speech, that coordination between agonist-antagonist muscles was reduced, and that sudden reductions in muscle activity occurred with the release of a stuttered word.

Articulatory responses during stuttered speech were examined with high speed cinefluorography by Zimmermann (1980). Stutterers showed frequent repositioning of articulators preceeding both fluent and disfluent utterances. Fewer synchronous relationships were found among articulators of stutterers in either fluent or disfluent utterances than for fluent utterances of a normal speaker. Relationships among articulators for perceptually fluent and disfluent utterances of stutterers were different from those found in fluent responses of a normal speaker.

While it might reasonably be expected that the disfluent speech of stutterers would be differentiated from the fluent speech of normal speakers along a number of physical continua (Van Riper, 1982), it is somewhat less obvious that the perceptually fluent utterances of stutterers would be physically differentiated from fluent utterances of normal speakers. However, a number of observations suggest that such differences exist.

Adams (1984) summarized a number of studies that indicated longer voice onset times occurred for fluent utterances of stutterers than for those of normal speakers. Freeman (1977) and Shapiro (1980) noted that perceptually fluent utterances of stutterers were often accompanied by disruptions in the usual coordination of laryngeal muscles. Conture (1984) suggested that electroglottographic wave forms might be different for fluent utterances of stuttering children when compared with those of fluent utterances from normal speaking children. Preliminary evidence was that the glottis was closed for approximately 70% of its cycle in the stutterer and only about 50% of its cycle in a matched comparison subject. Peters and Boves (1984) reported that subglottal air pressure build-up in fluent utterances of stutterers was often different from that observed in fluent utterances of normal speakers. In our laboratory, Bindewald (1978) found two conditions that generated fluent speech in stutterers were differentiated when frequency of voiced instances under 80 milliseconds in duration were examined. During white noise masking prior to entering therapy, the percent of voiced instances under 80 milliseconds in duration decreased compared with pre-entry scores. Posttherapy it was found that the frequency of voiced instances under 80 milliseconds increased and approximated those seen in the speech of normally fluent speakers. The interesting finding was that two different fluency generating conditions were differentiated in the vocal behavior of the stutterers.