

Stuttering: a molecular analysis of stuttering behavior.

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Summary

Introduction. Stuttering manifests itself in various ways and is influenced by different factors. Studies which poorly differentiated disfluency, mostly obtain unclear results. The moment of stuttering as the unit of analysis provides an inadequate approach for stuttering research. Major differences between stutterers and non-stutterers are missed. The variable results of research on the relationship between anxiety and disfluency in stutterers is mainly attributable to an inadequate differentiation of disfluency. Furthermore, anxiety is operationalized in these studies in a limited way; either as self-report reaction or as a psychophysiological reaction. Whereas, it appears that measures of anxiety utilizing self-report, behavioral or physiological systems, are mostly independent of each other.

Disfluency can be differentiated in several ways. The disadvantage of the frequently used method of categorizing stuttering behavior as primary or secondary stuttering, or as a type I or type II behavior, is that behaviors dissimilar in form are grouped together, whereas it is not yet known whether these are related. Johnson's approach, which utilizes 8 categories of disfluency is an important step forward. However, the limitation of this approach is that the categories 'broken words' and 'part-word repetitions' camouflage the differences between stutterers and non-stutterers.

In the present study the following research questions were investigated:

1. Differences between stutterers and non-stutterers in disfluency types and non-verbal behavior.
2. The clustering of related behaviors for stutterers and non-stutterers.
3. The relationship between anxiety and the clustered behaviors for stutterers and non-stutterers.
4. The effect of an adaptation procedure on anxiety and the clustered behavior for stutterers and non-stutterers.

Molecular analysis of stuttering behavior. In our study, we divided the 8 categories of Johnson further into 15 types of disfluency. Furthermore, we distinguished 18 non-verbal behaviors. We considered two components of anxiety, namely self-report of anxiety and autonomic arousal. Trait anxiety was measured with self-report inventories. State anxiety was measured with self-report inventories and the following psychophysiological responses: skin conductance level, spontaneous fluctuations/min and heart rate/min. The measurements were made during the quiet and out loud reading of a 230 word text by 48 male stutterers and 48 male non-stutterers ranging in age from 12 to 16 years.

We compared the observed disfluencies and non-verbal behaviors of stutterers and non-stutterers while they read the text out loud. Considerable differences were found between the two groups of subjects regarding both disfluency and non-verbal behavior. The disfluencies, which were only of more often found by stutterers were: rapid repetitions of single sounds, one syllable words and sound interjections, non-vocalized blocking accompanied by non-verbal behavior or phonation, non-vocalized blocking, breathing abnormalities, slow repetition of single sounds and words. The following disfluencies were equally frequent in both groups of subjects: interjections of extraneous sounds, slow repetition of syllables and repetition of phrases. Word interjections occurred more frequently with the non-stutterers than with the stutterers. In general, the disfluencies of the stutterers were localized at the initial sound of the word. The disfluencies of the non-stutterers were usually linguistic units, such as syllables, words

and phrases. The differences in disfluency found between stutterers and non-stutterers are contradictory to the hypothesis of Johnson (1967) and Bloodstein (1969) that stuttering develops, in one way, or another, from disfluencies occurring in non-stutterers.

The stutterers generally demonstrated more non-verbal behaviors while speaking than the non-stutterers. Typically, the stutterer demonstrated non-verbal behavior especially during disfluent speech. The non-verbal behavior which accompanies the disfluency of the stutterer might be under control of the aversive stimulus of the disfluency (escape/avoidance function) as well as a reflection of the extreme muscle tension during disfluent speech.

Clustering of stuttering behavior. Spearman rank correlation coefficients were calculated separately for both groups of subjects between the observed types of disfluency, eye blinks and a rest category composed of all other non-verbal behaviors. Factor analysis and cluster analysis of the disfluencies and non-verbal behaviors resulted in 5 groups of behavior for the stutterers and 2 groups for the non-stutterers.

Behaviors typifying the stutterers were found in 3 of the above mentioned groups. The first group consisted of non-verbal behavior during non-vocalized blocking or prolongation. The second group was composed of rapid repetitions of sounds and sound interjections. The third group consisted of non-vocalized blocking. The other behaviors observed with stutterers were grouped in a fourth cluster composed of disfluencies consisting of syllables, words and phrases. In addition, a fifth cluster was formed composed of slow repetitions and interjections of sounds. The fourth and fifth cluster of the stutterers were grouped in one cluster for the non-stutterers. The second cluster of behaviors for the non-stutterers was composed of non-verbal behaviors (except for eye blinks) and non-vocalized blocking.

Our analysis provides more differentiation than the a priori categorization of disfluency in type I and type II behaviors (e.g. Brutten & Shoemaker, 1967) or in primary and secondary stuttering (e.g. Bleumer, 1957).

Possibly, different factors affect the groups we have identified for the disfluency and non-verbal behavior of stutterers and non-stutterers. We consider the following factors as possibilities:

- a. Disorganization of the sensorimotoric pattern of speech movements (e.g. Stromstra, 1965).
- b. Postponement and avoidance of and escape from disfluency (e.g. Brutten & Shoemaker, 1967).
- c. A reflection of excessive muscular tension (non-verbal behavior).
- d. A deficit in syntactic and lexical skills (e.g. DeJoy & Gregory, 1977).

The possible impact of these factors is as yet a challenge for further investigation and research.

Anxiety and stuttering behavior clusters. Anxiety is central to psychological oriented theories of stuttering. An example of such theory is the two-factor theory of stuttering proposed by Brutten & Shoemaker (1967). We have investigated the differences between stutterers and non-stutterers regarding the autonomic and cognitive components of anxiety. No differences were found between the two subjects groups for trait anxiety and state anxiety during silent reading of the text and reading the text out loud. Contradictory with the two-factor theory of stuttering proposed by Brutten & Shoemaker, there were no differences found in 'classically conditioned' negative emotion (i.e. autonomic anxiety) between the stutterers and the non-stutterers. However, stutterers did report more stress during speaking situations than did non-stutterers.

We attribute the ambiguous results of research on the relationship between anxiety and disfluency mainly to poorly differentiated approach to both of these constructs. Thus the relationship was studied of the cognitive and autonomic components of anxiety with regard to specific behavior groups in stutterers and non-stutterers. Negative emotion appeared to influence these behaviors in the stutterer less than was generally assumed. It was only with the rapid repetitions of sounds and sound interjections that a correlation was found with autonomic reactivity and stress experienced during reading out loud. Similarly, experienced stress was also found to correlate with disfluencies concerning syllables, words and phrases and with the slow repetition and interception of sounds. With the non-stutterers, disfluencies with a repetitive or interjectional character appeared to be related to experienced stress. Hear rate correlated negatively with this group of behaviors. No correlation was found for the autonomic and cognitive components of anxiety with the non-verbal behaviors and the non-vocalized blocking of non-stutterers.

We assume that the groups of disfluency which typify the stutterers are the result of inadequate development of co-articulation and coordination of breathing, phonation and articulation. Non-vocalized blocking and rapid repetition of sounds and sound interjections have been perceived as primary forms of stuttering. These behaviors are likely under the influence of different factors. We have assumed that sensorimotoric deficits are the cause of non-vocalized blocking. Autonomic and cognitive components of anxiety were found to be related to the rapid repetition of sounds and sound interjections. The association of the indices of autonomic anxiety with the rapid repetitions of the stutterer was in agreement with the two-factor theory of Brutten & Shoemaker (1967). The non-verbal behaviors of the stutterer which accompany non-vocalized blocking and prolongation may either be perceived as motoric struggling or be perceived as automatic avoidance or escape behaviors.

The disfluency of the non-stutterer consisted mainly of the interjection of words and sounds and the slow repetition of words, phrases, syllables and sounds. This form of disfluency appeared to be localized at the juncture of syntactic elements. We assume that this form of disfluency originates from cognitive processes with govern the structuring of language into syntactic and meaningful units. Similarly, these behaviors may operate in the same way in stutterers, as well as serving their previously mentioned avoidance or escape function.

Stutterers and non-stutterers reacted to read the text aloud with a considerable increase in autonomic arousal from the rest condition. This increase might be attributed to the test situation of the reading task in the presence of the experimenter. A high level of attention to the reading task might facilitate the syntactical and lexical skills of the non-stutterer, and thus inhibit the disfluency characteristic of the normal speaker. We found no indications for a similar effect for stutterers. The attention of the stutterer is most likely directed towards the prevention of stuttering in its manifestations of rapid repetitions, prolongations and non-vocalized blockings.

Adaptation. The repeated performance of the same speaking task results in a decrease in disfluency in most of the stutterers. This phenomenon is called adaptation and is assumed to be associated with anxiety reduction, fatigue or increasing motoric-linguistic skills. We investigated the effect of an adaptation procedure in 48 stutterers and 48 non-stutterers with respect to total disfluency, specific groups of disfluency, experienced stress during text reading and autonomic reactivity. Both groups of subjects demonstrated during 5 consecutive readings of the text aloud adaptation with respect to total disfluency. They also demonstrated a reduction in experienced stress and a decrease in 2 of the 3 indices of autonomic reactivity. The adaptation effect was found to be rather similar with respect to the clusters of behavior in the two groups of subjects. The exception to this was that the cluster of slow repetitions, words and phrases showed no adaptation by the stutterers. It was concluded that changes in anxiety,

motoric and syntactical skills can simultaneously occur in various ways, in the speaker, during the repeated reading aloud of the text. Because of this complexity, we found the adaptation procedure of little value in discriminating the separate clusters of stuttering behaviors.