Clusters of stuttering behavior and a model for differential diagnostics and treatment of stuttering

Floor Kraaimaat and Peggy Janssen

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Abstract

Stuttering therapy is handicapped by the use of a rather molar concept of disfluency and nonverbal behavior of persons who stutter (PWS). In this article, the results of molecular analysis of disfluency and nonverbal behavior in 54 children who stutter (CWS) and 33 children who do not stutter (CWNS) are presented. Groups of stuttering behaviors were formed using factor and cluster analysis and compared with the results of an earlier study with adolescent PWS and PWNS. Groups of behavior found in the school-age children and the adolescents were highly congruent. A differentiated application of therapeutic procedures in stuttering is proposed using the relationship of our empirical groups of behaviors with anxiety and language skills.

Keywords: disfluency, diagnostics, tailored therapy, behavioral clusters, stuttering

Introduction

In the recent literature about the direct causes of the disturbances in fluency various contributing factors are mentioned, such as stress and anxiety (Brutten & Shoemaker, 1967), sensomotoric disturbances (Van Riper, 1982), and deficit linguistic and lexical skills (Bloodstein, 1981). The contribution of these determinants in the development of stuttering is unclear. One of the reasons why this is the case might be the use of a too general and molar definition of disfluency. A common practice in research and therapy is to combine different disfluencies under the umbrella of the stuttering moment. Recently and in line with the theoretical approach of Brutten & Shoemaker (1967, 1972) repeatedly objections were made against this practice. The main opposition is against the underlying contention that the behaviors of the person who stutters (PWS) are under control of the same determinant. More likely is that different factors control the various behaviors of the PWS and thus require a different therapeutic approach.

Several authors have suggested classifications of stuttering behavior, but these suggestions were disregarded in research and therapy. A limitation of the proposed classifications is that they are without exception a priori formulations. Aim of the present article is to propose on the basis of empirical data, a model for differential diagnostics and treatment of stuttering. The data stem from two earlier published studies (Janssen & Kraaimaat, 1980, Janssen, Kraaimaat & Van der Meulen, 1983) and an investigation in 6-9 yrs. old children who stutter (CWS) and children who do not stutter (CWNS) presented in the first and second part of this article below. Presented are only results of these studies that are relevant for the development of a model for a differentiated application of therapeutic procedures. The following research questions are successively dealt with: What are the characteristic differences in disfluency between PWS and PWNS? Can empirically constructed groups of behavior be distinguished in PWS and PWNS? What is the relationship between these groups of behavior with anxiety and language skills? We conclude with a proposition of a model for differential diagnostics and treatment of stuttering.

Differences in disfluency between elementary school CWS and CWNS

In earlier studies with adolescent PWS and PWNS, it was demonstrated that these subjects were distinguished by groups of specific disfluencies, while other groups of disfluencies did overlap (Janssen & Kraaimaat, 1980, Kraaimaat, 1980). Given the contention that stuttering develops in tracks and increases in severity, a replication was undertaken of these earlier studies in a younger group of subjects. Subjects in the present study were 54 CWS and 33 CWNS between 6 to 9 yrs. The CWS were referred to therapy and on a waiting list. None of the CWS had a history of speech therapy. In addition, none of the CWNS had a speech- or language problem in their past or at the time of the study. The procedure and method of this study were similar to that of Janssen & Kraaimaat (1980) and Kraaimaat (1980).

The subject's task consisted of the oral reading of a 230-word passage adjusted at the age of the subject in the presence of an experimenter. Each subject was tested individually. All oral readings were recorded on a video recorder for later analysis. The speech samples were analyzed according to the following 15 types of disfluency: fast sound repetitions, fast word repetitions, prolongations, sound prolongations (within a word), non-tense blocks, tense blocks (blocks with concomitant inappropriate movements or fixations of the face or head), vocalized blocks (blocks with concomitant audible struggle behavior), sound interjections, word interjections, slow sound repetitions, slow syllable repetitions, slow word repetitions and phrase repetitions.

Table 1. Disfluencies of elementary school CWS (n=54) and CWNS (n=33)

	CWS		CWNS		
	mean	% of total disfluency	mean	% of total disfluency	P-value
Fast sound repetition	3.11	8	-	-	-
Fast word repetition	.11	0	-	-	-
Prolongation	2.71	7	.04	1	-
Sound prolongation	1.02	3	-	-	-
Non-tense block	3.23	8	.09	1	.001
Tense block	8.64	22	-	-	-
Vocalized block	.37	1	-	-	-
Sound interjection	1.79	5	.61	10	ns
Word interjection	2.19	6	1.63	25	ns
Slow sound repetition	4.74	12	.42	7	.001
Slow syllable repetition	1.94	5	.40	6	.001
Slow word repetition	7.61	20	1.48	23	.001
Phrase repetition	2.40	6	1.77	28	ns

In Table 1, the mean and percentage of total disfluency of each type are represented for CWS and CWNS. Higher frequencies were found of all types of disfluency in CWS except for sound and word interjections and repetition of phrases. Noteworthy is the absence in CWNS of fast repetitions of a sound and a one-syllable word, prolongation, tense block and vocalized block. These findings do correspond with those of our study in the older age groups between 12 and 16 yrs. Thus even at a relatively early age, stuttered speech is characterized by fast repetitions and prolongation (most elementary speech unit) and blocks accompanied with observable physical tension.

Next, an analysis was performed of the nonverbal behaviors that occurred during the speech of the CWS and CWNS. Nonverbal behavior was defined as any observable movement of the orofacial structure that was not an integral part of the ongoing process of speech. The following 6 categories

were employed: eye blinks defined as the fast closure of an eye or eyes, eyebrow movements defined as excessively raising the eyebrows or wrinkling the forehead, eyelid movements including complete and partial closing of the eyes and enlarged eye openings, head movements including movements back, down or to either side, tongue and mouth movements, and a general category of looking away and touching nose, hair or spectacle. Due to differences in reading time, the frequencies of the six categories were calculated per minute. Nonparametric Mean-Whitney t-tests were used because of a deviation of the normal distribution of the variables. The mean and percentage of each category are presented in Table 2.

Table 2. Nonverbal behaviors during the speech of elementary CWS (n=52) and CWNS (n=33).

	CWS		CWNS		
	Mean	% of total nonverbal behavior	Mean	% of total nonverbal behavior	p
Eye blinks	12.53	56	9.52	64	ns
Eyebrow movements	4.87	22	3.35	22	ns
Eyelid movements	1.34	6	0.24	2	ns
Head movements	0.42	3	0.17	1	ns
Tongue and mouth movements	2.94	13	0.98	7	.002
Looking away and touching nose, hair or spectacle	0.42	2	0.76	5	.03

Both groups of subjects displayed all categories of nonverbal behavior. Movements of tongue and mouth were more frequently observed in the CWS, while the general category of looking away and touching nose, hair, or spectacle was more perceived in the CWNS. Generally, a considerable individual variation was observed in both groups of subjects. Some children, even some children in the stuttering group, did not display any category of nonverbal behavior. These results correspond with those of our earlier studies with 12 to 16 years of age children. Thus the occurrence of nonverbal behavior during speech is not a characteristic of the relatively young child who stutters. However, characteristic of children who stutter is that about 50 % of their nonverbal behaviors co-occur in time with blocks and prolongations. Noteworthy is that this co-occurrence of disfluency and nonverbal behavior was absent in the CWNS.

Clusters of disfluencies and nonverbal behaviors of elementary school CWS and CWNS

As in our earlier studies use was made of two reduction methods, an exploratory factor analysis (Principal axes, Varimax rotation, Kaiser normalization), and hierarchical cluster analysis (Johnson, 1967, maximum method). Both methods were performed with Spearman rank coefficients to deal

with deviances from the normal distribution (Digman, 1966). A summary of the results of both statistical methods is presented in Table 3.

Table 3. Summary of the results of factor- and cluster analysis of elementary CWS and CWNS.

CWS (n=54)

Cluster A	Tense block Tongue and mouth movements Eyebrow movements
Cluster B	Fast sound repetitions Prolongations
Cluster C	Non-tense block
Cluster D	Slow sound, syllable, and word repetition Eyelid movements
Cluster E	Phrase repetitions Eye blinks
Cluster F	Word interjections Looking away and touching head, nose or spectacle

CWNS (n=33)

Cluster a	Slow sound, syllable, and word repetitions Phrase repetitions Sound and word interjections
Cluster b	Tongue and mouth movements Eye blinks
Cluster c	Looking away and touching the head nose or spectacle

The results of the factor and the cluster analysis correspond very much with those found in children between the ages of 12 and 16 (Janssen & Kraaimaat, 1980, Kraaimaat 1980). Also in the younger CWS, the a priori classification of characteristic stuttering disfluency (cluster A and B) is distinguished from the so-called normal disfluency (cluster D, E, and F). While cluster C (non-tense block) might be viewed as a transition between stuttering and normal disfluency. In the PWNS all disfluencies are allocated in the cluster a. Furthermore, in CWNS disfluency and nonverbal behavior during speech are independent categories.

Relationship of clusters of disfluency and nonverbal behavior with anxiety and language skills.

The comparison of the 6-9 years CWS and PWNS with the older subjects in the age of 12-16 years, revealed striking similarities. In this part, we combine the results of the two different age groups to elaborate on the relationship of the disfluency clusters with anxiety and language skills. The role of anxiety was investigated in the age group between 12 and 16 yrs. and the role of language skills in the age group between 6 and 9 yrs.

Two components of anxiety were investigated in the study of Janssen & Kraaimaat (1980), namely autonomic reactivity (skin conductance, spontaneous fluctuation of skin conductance, and heart rate). Reactivity measures were obtained by calculating change scores between the pre-task period and the task period. Subjective anxiety during the reading task was measured using a 5-point scale. The relationship between the two components of anxiety is presented in the first and second column

of Table 4. Note that due to the combining of the two age groups, the listing of the clusters is somewhat different from that of Table 3. Autonomic reactivity is only associated with fast repetitions and interjections (cluster B) in the CWS. In addition, in CWS, subjective anxiety is associated with cluster B and also with two clusters of normal disfluencies (cluster D and cluster E). All disfluencies of the CWNS were allocated in one cluster and were negatively associated with autonomic reactivity and positively associated with subjective anxiety. Thus the role of anxiety in the occurrence of disfluency is quite different between CWS and CWNS. We interpret this difference as follows: in CWS autonomic reactivity contributes to a disintegration of speech that manifests itself in fast repetitions and interjections (see Brutten & Shoemaker, 1967) and is linked with subjective anxiety. Further, subjective anxiety is associated in CWS with two clusters of normal disfluencies (cluster D and cluster E) which might have an escape or avoidance function of kernel disfluency.

Table 4. Relationship between specific behavior clusters and three determinants of stuttering

CWS		Autonomic reactivity	Subjective anxiety	Language kills
Cluster A	Tense-block Prolongations Head movements Tongue and mouth movements Eye blinks	ns	ns	ns
Cluster B	Fast sound repetitions Fast sound interjections Fast word repetitions	X	X	ns
Cluster C	Blocks Vocalized blocks	ns	ns	ns
Cluster D	Slow syllable repetitions Slow word repetitions Phrase repetitions	ns	X	ns
Cluster E	Sound interjections Slow sound repetitions Breathing irregularities	ns	X	ns

CWNS		Autonomic reactivity	Subjective anxiety	Language skills
Cluster a	Slow sound repetition Slow syllable repetition Slow word repetition Phrase repetition Sound interjections Word interjections	X (negative)	X	X
Cluster b	Head movements Tongue and mouth movements Non-tense block	ns	ns	x

Autonomic reactivity in CWNS might reflect increased attention at the reading task due to task stress. In this case, increased attention facilitates (a negative correlation) the syntactic and sensomotoric skills of the CWNS.

The study of Janssen, Van der Meulen & Kraaimaat (1983) investigated the relationship between 10 types of disfluency and language skills in the younger age groups. Three standard Dutch reading tests were used to assess the language skills of the CWN and CSNS. A summary of the correlations between the reading test performances and the clusters of disfluency is presented in the fourth column of Table 4. In CWS, there was no association at all between disfluency and language skills. Noteworthy is that this concerned the so-called characteristic disfluencies as well as normal disfluencies. The disintegration of speech of the CWS has no relation with their capacity to comprehend and produce speech. The CWNS disclose an entirely different picture. In the non-stuttering group, the less language skilled readers are also the most disfluent ones. Summing up, no support was found for the contention that language problems are essential determinants of stuttering.

A model for differential diagnostics and treatment of stuttering

At this point, it is of interest to consider the implications of the results mentioned above for the treatment of the person who stutters. A proposal for differential diagnostics and the tailoring of treatment is presented in Figure 1 (see also Janssen, 1985). The following four components are distinguished that may be at stake in the development of stuttering: a motoric component revealing sensomotoric disruptions in the production of speech, a linguistic component that involves a dysfunction in the coding and decoding of language, an anxiety component with origins in autonomic reactivity, and a component consisting escape and avoidance behaviors of kernel disfluencies and thus contributes to the maintenance of stuttering.

Component	*Behavioral pattern*	*Treatment procedures*
Motoric dysfunction	prolongations, tense and non-tense blocks, nonverbal 'struggle' behavior	fluency training, cancellation, EMG-biofeedback, breathing exercises
Linguistic dysfunction	repetitions of syllable, word or phrase, sound and word interjections, articulation errors	language training
Autonomic anxiety	fast sound and word repetitions, fast sound interjections	graded exposure, stress management training
Avoidance and escape behavior	repetitions of syllable, word, and phrase, sound and word interjections, orofacial movements	self-monitoring, response prevention

***Figure 1*. Differential diagnostics: a model for tailor-made treatment**

Prolongations and blocks are the characteristic behavioral pattern of the motoric component. At present, there is ample support for the contention of a sensomotoric dysregulation (e.g., Andrews at al., 1983). In case of a dominant pattern of these disfluencies treatment procedures such as fluency

training, cancellation, EMG-biofeedback, and breathing exercises are indicated (e.g., Janssen, 1985, Lanyon, 1978, Ryan, 1974, Schwartz, 1974, Van Riper, 1973, Webster, 1978).

The dominant disfluencies of the CWNS are a pattern of slow repetitions, interjections, and articulatory errors. This pattern is related to a weak capacity for language. In the case of domination of this behavioral pattern in the young child, language skills training is highly recommended.

Autonomic anxiety is associated with fast repetitions and interjections. Effective treatments are anxiety reduction procedures such as a graded exposure with fear eliciting situations, and stress management training.

Slow repetitions and interjections function as escape and avoidance behaviors. Self-monitoring and response prevention of these behaviors are indicated to reduce these types of disfluency. However, with the restriction that the treatment also focuses, if present, on the characteristic disfluencies (i.e., prolongations, blocks, fast repetitions).

To assess the relative contribution of each component mentioned above, next to a molecular analysis of the observed disfluencies, the use of anxiety and language measures is crucial. The contribution of each component might vary in the individual PWS. Clinical practice shows the dominance of one or two components, which simplifies the arrangement of an individually tailored treatment. Our current research is aimed at the evaluation of the model by employing several case studies. With promising first results, as is often the case.

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