Kraaimaat, F.W. (1980). **Adaptation of stuttering behaviors and reduction of anxiety.** In F.W. Kraaimaat, *Stuttering: a molecular analysis of stuttering behavior* (pp. 87-103). Lisse: Swets & Zeitlinger. (Abbreviated and translated from the Dutch)

Abstract

An adaptation procedure was performed with 48 PWS and 48 PWNS concerning total disfluency, specific clusters of disfluency, experienced stress during text reading, and autonomic reactivity. Both groups of subjects demonstrated during five consecutive readings of the text adaptation of total disfluency. They also demonstrated a reduction in task anxiety and a decrease in 2 of the three indices of autonomic reactivity. The adaptation effect was found to be somewhat similar to the clusters of stuttering behavior in the two groups of subjects. In PWS, a reduction of task anxiety was associated with the adaptation of a cluster of disfluencies consisting of nonverbal behavior, tense blocks and prolongations, and a cluster of disfluencies containing non-tense blocks and vocalized blocks. While the adaptation of a cluster of disfluencies consisting of fast repetitions and interjections was related to the relative increase in skin conductance level. In PWNS, no associations were found between the adaptation of disfluency and subjective and autonomic anxiety. It was concluded that changes in anxiety, motoric as well as syntactical skills might separately and simultaneously be at stake in the adaptation of stuttering behavior. Because of this complexity, we found the adaptation paradigm of little value in exploring factors involved in the adaptation of clusters of disfluency in PWS and PWNS.

Introduction

In persons who stutter (PWS) and persons who do not stutter (PWNS), repeated reading of the same material led in most subjects to a decrease in disfluency. This phenomenon is known as the adaptation effect. When after an adaptation procedure, a rest period is introduced, there is an increase in stuttering frequency. Such an increase is called spontaneous recovery. The first studies which investigated the phenomena of adaptation and spontaneous recovery (Van Riper & Hull, 1935; Wischner, 1950) started a wide range of studies to explore the factors involved. It was assumed that the factors involved in adaptation might also be of use in the treatment of stuttering (e.g., Brenner, Perkings & Soderberg, 1972; Golub, 1956; Starbuck & Steer, 1953; Wingate, 1966, 1972). The results of these studies showed that the following factors facilitate stuttering adaptation:

a. No changes in the speech situation.
b. The use of the same reading text.
c. A relatively short time interval between the readings.
d. The extent to which articulation and phonation occur during the reading of the text.

In literature, adaptation is suggested to be related to anxiety reduction, fatigue, and motoric-linguistic skills. Anxiety reduction is mentioned by Johnson (1967), Wischner (1950, 1952), and Sheehan (1970). Brutten (1963) investigated the course of disfluency and anxiety and found a similar curve in both variables. However, this result could not be replicated in a similar experimental condition (Gray & Brutten, 1965). Note that these authors assume that speech elicited anxiety is the cause of a disintegration of speech that manifests itself in a type I disfluency (sound repetitions and prolongations). Brutten & Shoemaker suppose that there is not a necessary relationship between anxiety and disfluency in the case of an adaptation procedure. However, they assume that the level of anxiety does affect the extent of disfluency of the first reading trial. According to Brutten & Shoemaker (1967), fatigue or reactive inhibition might be specifically a cause of adaptation of the type II stuttering behaviors (e.g., interjections and repetitions of words and phrases). Reactive inhibition stems from the learning theory of Hull (1943), which postulates ‘the evocation of any reaction generates reactive inhibition, a disinclination to repeat that response.' Frank & Bloodstein (1971) performed an adaptation study in 15 PWS with two conditions, namely 5 times consecutively reading out loud of a standard text, and a similar one in which the subject read the text in unison with the experimenter. It is known that reading out lout in unison reduces the subject's disfluency. No differences were found between the number of disfluencies in a sixth recovery trial between both conditions. Thus it might be the reading out loud of the text and not the occurrence of disfluency that is a determining factor in stuttering adaptation. Wingate (1966), Brenner at all (1972), and Bloodstein (1972) assume that stuttering adaptation is due to an increase in motoric-linguistic skills of the PWS.

A disadvantage of the studies above is that use is made of the stuttering moment or the total number of disfluencies. Thus it is of interest to study the adaptation effect concerning the separate clusters of stuttering behavior that were revealed in an earlier study (Kraaimaat, 1980a). Reduction of anxiety, reactive inhibition as well as motoric-linguistic skills can be at stake in the adaptation of distinct clusters of disfluencies and nonverbal behavior. A difficulty with respect to the relationship between anxiety and stuttering is that various and contradicting results are reported in the literature (e.g., Brutten, 1963 and Gray and Brutten, 1965). This state of affairs is due to the fact that cognitive/self-report and autonomic anxiety indices are interdependent (Lang, 1971; Mathews, 1971). The interaction between the cognitive, behavioral, and physiologic systems involved in anxiety are complex, and changes in these systems do not occur synchronously (Lang & Lazovik, 1963). Thus it is not advisable to use a single parameter of anxiety in investigations regarding the role of anxiety in stuttering.

In a previous study, we demonstrated that PWS and PWNS reacted similarly to reading a text aloud with a considerable increase in cognitive and autonomic anxiety from a rest condition (Kraaimaat, 1980b). In addition, the cognitive and autonomic components of anxiety were related quite differently with the characteristic disfluencies of the PWS and the PWNS. Further support for a different role of anxiety in the disfluencies of PWS and PWSNS may be found by means of an adaptation procedure, which is suggested to result in a decrease of anxiety as well as disfluency.

The purpose of the present study is twofold, firstly to compare between PWS and PWNS the adaptation of total disfluency, task anxiety, and autonomic reactivity. Secondly, to compare between PWS and PWNS the adaptation of distinct clusters of disfluencies and nonverbal behavior and their relationship with the adaptation of task and autonomic anxiety.

Method

Subjects.

The subjects were 48 young male PWS and PWNS between the ages of 13 and 16 years. None of the PWS was in therapy at the moment of data collection. No subjects included in the PWNS group had a history of previous speech disorders.

Procedure.

The subject's task consisted of the five times consecutive reading out loud of a 230-word passage in the presence of an experimenter. Each subject was tested individually. All oral readings were recorded on a video recorder for later analysis. Before the reading task, the subjects were requested to remain quietly seated for 10 minutes to allow the pretest assessment of physiological measures. To obtain a measure of task anxiety the subject rated his tension state after each of the readings on a 5-point Likert scale.

Analysis of disfluency and nonverbal behavior.

The speech sample was analyzed according to the following 15 *types of disfluency*: fast sound repetitions, fast word repetitions, prolongations, sound prolongations (within a word), tense blocks (blocks with concomitant inappropriate movements or fixations of the face or head), non-tense blocks, vocalized blocks (blocks with concomitant audible struggle behavior), sound interjections, fast sound interjections, word interjections, slow sound repetitions, slow syllable repetitions, slow word repetitions, phrase repetitions and breathing irregularities. *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 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, mouth movements including pressing lips together, pursing lips and sideway lip movements and jaw movements, looking away and touching nose, hair or spectacle. Due to a high variation in observed frequency within and between subjects two main categories were formed, namely eye blinks and a rest group of all other observed nonverbal behaviors (see Kraaimaat, 1980b)

Clusters of disfluency and nonverbal behavior

With the Spearman rank correlation coefficients between the types of disfluency and two categories of nonverbal behavior, an exploratory factor analysis and a cluster analysis was performed at the data of the first reading trial with resulted in five clusters in the PWS and two clusters in the PWNS (see Kraaimaat, 1980c).

The following clusters were formed in the PWS: *Cluster A*: rest nonverbal behavior, tense block, eye blinks and prolongation, *Cluster B:* fast sound repetition and fast sound interjection, *Cluster C*: non-tense block and vocalized block, *Cluster D*: slow syllable, word and phrase repetition*, Cluster E*: breathing or sound interjection and slow sound repetition. The two clusters in the PWNS were: Cluster *a: slow sound, syllable, word or phrase repetition, and sound or word interjection. Cluster b*: rest nonverbal behavior and non-tense block. Due to the deviancies of the normal distribution, a log (x + 1) transformation was performed on the obtained data before calculating parametric statistics.

Measures of self-reported and autonomic anxiety

Self-report of task anxiety was obtained by the subject's rating of the extent to which they experienced anxiety after each oral text reading on a 5-point Likert scale.

Autonomic anxiety was continuously measured using the subject's skin conductance and heart rate. All physiological responses were recorded on FM-tape on an Ampex instrumentation tape recorder for later analysis on a PDP-15 computer, and a Van Gogh polygraph (17 ERP-16 BZA). *Skin resistance* was recorded employing AG-AGCL electrodes placed on the palmar side of the first phalange of the first and third fingers of the subject's left hand. Raw data were converted to log conductance values per minute by the computer to obtain a *skin conductance* score. Besides, the number of *spontaneous fluctuations* were calculated per minute. A spontaneous fluctuation equalizes a change in the base level of .5 Kohm minimally. Heart rate responses were measured utilizing AG-AGCL electrodes placed on the subject's left leg and right wrist, with an electrode on the right leg serving as ground. Raw data were converted to R-R intervals by the computer, and the inter-pulse interval data subsequently converted to rate per minute. Heart rate and skin conductance responses were sampled during the last 5 minutes of the pretest rest period and the first minute of each reading task. Autonomic reactivity measures were obtained by computing change scores between the pretest and each reading period (see Janssen & Kraaimaat, 1980).

A measure of individual adaptation of disfluency and autonomic reactivity was obtained by calculating residual gain scores (Kerlinger. 1975). Residual gain scores were calculated by subtracting the predicted value of trial 5 with the observed value of that trial. The scores on the first trial were used for the prediction scores of the fifth trial. All calculations were performed utilizing a log (x + 1) transformation of the absolute frequencies.

Results

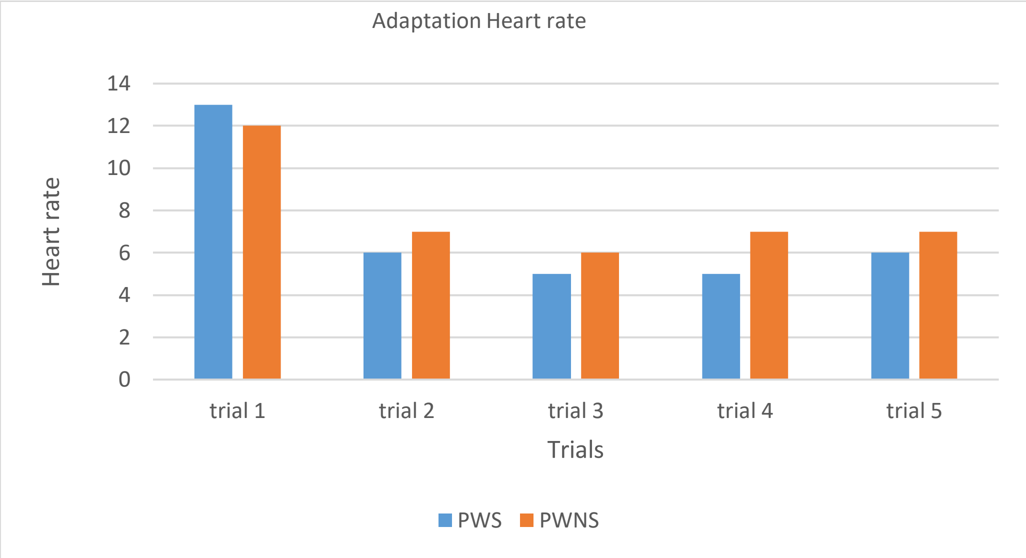
To assess the adaptation of total disfluency, task anxiety and autonomic reactivity measures analyses of variance (Winer, 1971) were calculated with two factors (groups) and repeated measurements of 1 factor (trials). As can be seen in Table 1, the PWS displayed over the five trials a higher frequency of total disfluency and a higher level of task anxiety.

Table 1. Adaptation of Total disfluency, Speech anxiety and Autonomic Reactivity concerning five reading trials (B) and a group of PWS and of PWNS (A)

		Group (A)	Error between	Trials (B)	A x B	Error within
Total disfluency	MS	177.69	4.56	5.79	.22	.13
	F	36.94**		45.56**	1.76	
Task anxiety	MS	7.75	1.88	24.33	.05	.29
	F	4.12*		83.32**	.17	
Skin Conductance Level	MS	.03	.06	.05	.01	.001
	F	.57		52.05**	10.53**	
Spontaneous Fluctuations	MS	112.39	37.74	75.47	5.33	2.65
	F	2.98		28.49**	2.01	
Heart rate	MS	193.68	232.53	577.36	46.91	17.96
	F	.83		32.15**	2.61**	

* P < .05; ** p < .001

A significant adaptation effect was found in PWS as well as PWNS with respect to total disfluency, task anxiety, and the autonomic reactivity measures (skin conductance level, spontaneous fluctuations, heart rate). As expected, the PWS showed a higher frequency of disfluencies and task anxiety than the PWNS across all five trials. The course of adaptation across trials did not differ between both groups of subjects concerning the frequency of total disfluency, task anxiety, and spontaneous fluctuations. However, the course of adaptation between PWS and PWNS was somewhat different for heart rate and skin conductance level and (Figure 1). However, for both groups of subjects, the highest adaptation occurred from trial 1 to trial 2. Noteworthy is the increase in skin conductance level from trial 2 to trial 5 in PWS as well as PWNS. At trial 5, the skin conductance level of the PWS was significantly higher than that of the PWNS.



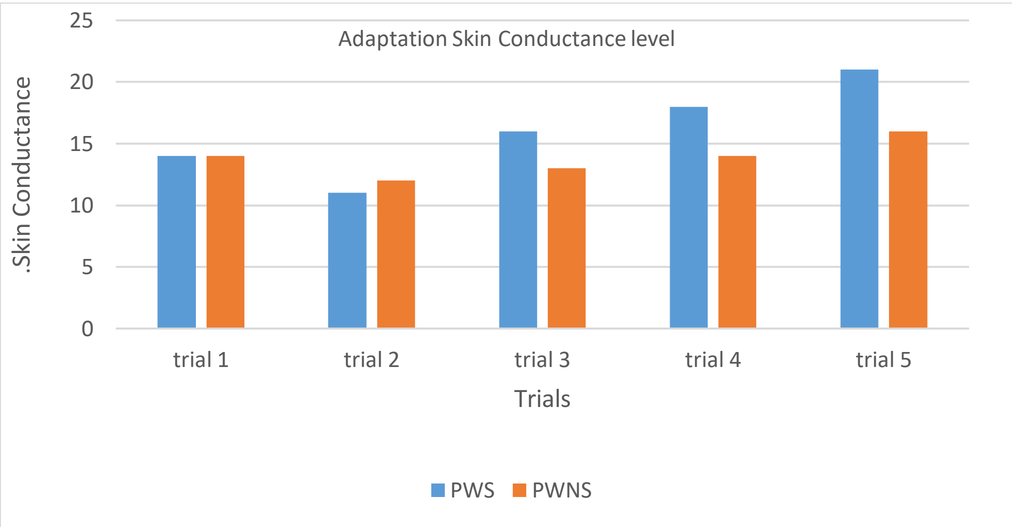


Figure 1 Adaptation of Heart rate and Skin Conductance level of PWS and PWNS

The effect of repeated reading a text out loud on the five clusters of behaviors distinguished in PWS and the two clusters of the PWNS was assessed with variance analyses with repeated measures on one factor (Winer, 1971). As can be seen in Tables 2 and 3, a significant adaptation was found in all clusters of behaviors in both groups of subjects. Similar to the total frequency of disfluency of PWS and PWNS, the highest decrease occurred in all separate clusters of behaviors between trial one and trial 2 (results not presented here).

Table 2 Analyses of variance for the 5 clusters of behavior of the PWS

		Trials (df=4)	Error (df=188)
Group A	MS F	1.60 21.75**	.07
Group B	MS F	2.93 13.06**	.22
Group C	MS F	3.83 16.13**	.24
Group D	MS F	1.24 5.62**	.22
Groups E	MS F	1.18 4.34*	.27

Table 3 Analyses of variance for the 2 clusters of behavior of the PWNS

		Trials (df=4)	Error (df=188)
Group a	MS F	2.08 13.69**	.15
Group b	MS F	1.28 8.12**	.16

In an earlier study, we found that subjective/cognitive and autonomic anxiety was differently related to the separate clusters of behavior of PWS and PWNS. To investigate the relationship between a change in the anxiety measures and the adaptation of clusters of disfluencies in both groups of subjects, correlation coefficients were calculated between the obtained residual gain scores (see Tables 4 and 5).

Table 4. Correlation between residual gain scores for the PWS.

	Group A	Group B	Group C	Group D	Group E
Task anxiety	**.36**	.16	**.30**	.23	.01
Skin Conductance level	.04	**.32**	.11	.24	.13
Spontaneous fluctuations	-.02	-.16	-.08	.24	-.07
Heart rate	.18	.20	.10	-.02	-.12

r > .28 then p < .05

Table 5. Correlation between residual gain scores for the PWNS.

	Group a	Group b
Task anxiety	.13	.03
Skin Conductance level	.15	.14
Spontaneous fluctuations	.14	.03
Heart rate	-.21	.12

r > .28 then p < .05

In PWS, a change in skin conductance level was associated with adaptation of cluster B (fast repetitions and fast interjections). Also, a decrease in task anxiety was related to an adaptation of cluster A (rest nonverbal behavior, tense block, eye blinks, and prolongation) and cluster C (non-tense block and vocalized block). In PWNS, no association was revealed between a decrease in task anxiety and autonomic reactivity with the adaptation of the two clusters of behavior.

Summary and discussion

Across the five reading trials, a higher level of task anxiety was found in the PWS in comparison with the PWNS, but no differences were found for the autonomic reactivity measures between both groups of subjects. The higher state anxiety in the PWS might indicate that next to the experienced stress of the experimental situation, also speech-related anxiety was at stake. Kraaimaat (1980b) found that cognitive/self-report and autonomic anxiety indices were in PWS specifically related to a cluster of stuttering behavior consisting of fast repetitions and interjections. Thus the finding that it was not autonomic anxiety that differentiates PWS from PWNS might indicate that PWS are more vulnerable to the disintegration of speech when exposed to anxiety eliciting situations (Brutten & Shoemaker, 1967).

PWS, as well as PWNS, demonstrated a significant adaptation of total disfluency and the separate clusters of disfluencies that were distinguished in the present study when they read five times consecutively a standard text. Similar to the literature, the steepest decrease in disfluency occurred from the first to the second trial. Hence adaptation of disfluency is a rather general phenomenon that is not restricted to PWS or PWNS nor to the separate clusters of disfluencies that were used in the present study.

It is known from the literature that when a subject is exposed for a relatively long duration or repeatedly to a fear eliciting stimulus or situation that this results in a decrease of anxiety (e.g., Marks, 1975). Similarly, the repeated text reading resulted in a reduction of task anxiety and the autonomic reactivity measures of heart rate and spontaneous fluctuations in PWS and PWNS. Although skin conductance level did decrease from the first to the second reading, it increased from the second until the fifth reading in both groups of subjects. The latter finding is somewhat in contrast with the decrease of the other anxiety measures. Nevertheless, note that the cognitive/self-report and autonomic anxiety measures are interdependent. A possible explanation is that the repetitive reading requires extra attention of both groups of subjects to perform the task as might be expressed by the increase in the level of skin conductance, (see also Malmo, 1965). Furthermore, the course of the decrease in heart rate and skin conductance level was somewhat different between PWS and PWNS. These differences might be due to the longer reading time of the PWS in comparison with the PWNS ($p < .001$) and thus a longer duration of exposure to the experimental situation.

In literature it is suggested that the repeated reading of a text might not only lead to a reduction of disfluency and anxiety, but also to an increase of fatigue and a rise in motoric and linguistic skills (Bloodstein, 1972; Brenner et al., 1972; Brutten & Shoemaker, 1967; Wingate, 1966). In the present study, only the role of anxiety was considered. During the reading of the text, a decrease in task anxiety was associated in PWS with a decrease in two clusters of disfluency, respectively, a cluster consisting of rest nonverbal behavior, tense block and prolongation, and a cluster containing non-tense and vocalized blocks. Task anxiety is a cognitive/self-report measure that is composed of two aspects; it might refer to the subject's awareness of the difficulties and motoric efforts that were experienced during reading out loud, as well as to the stress of the experimental situation. The adaptation of a cluster of disfluencies consisting of fast repetitions and interjections was associated with a relative increase in skin conductance level but not with a change in task anxiety, heart rate, and spontaneous fluctuations. Note that at the first reading trial, this cluster of disfluencies was associated with task anxiety as well as all three indices of autonomic anxiety (Kraaimaat, 1980b). Probable an overall lower level of anxiety in the PWS at the fifth trial might have contributed to the lessening of the association between anxiety and the cluster of disfluencies consisting of fast repetitions and interjections. Thus therapeutic interventions aimed at a reduction of anxiety might be effective in PWS who demonstrate a high frequency of fast repetitions and interjections.

In PWNS, the adaptation of the two separate clusters of disfluency was not related to a decrease in the cognitive/self-report and the autonomic anxiety measures. We assume that the adaptation of the disfluencies of the PWNS is related to an increased linguistic proficiency caused by the consecutively five times reading of the text. Note that in PWNS, a high frequency of their prevailing disfluencies (i.e., slow syllable, word, and phrase repetitions) is suggested to be related to a relatively weak capacity for language (Kraaimaat, 1980a).

In conclusion, the usefulness of the adaptation paradigm was found to be limited in disentangling factors involved in the disfluencies of PWS as well as PWNS. Specifically, since repeated text reading contributes to a decline of anxiety as well as an increase in the linguistic and motoric proficiency of the subjects involved. The latter complexity might have been the reason that no differences were found in the occurrence of adaptation between the separate clusters of disfluencies of PWS and PWNS.

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