The Use of Prolonged Speech in the Treatment of Apraxia of Speech

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A relatively common feature of therapies for patients with apraxia of speech is that they are conducted in the context of reduced rates of speaking (Rosenbek, 1978; Wertz, 1978). The reduced rate of speaking is assumed to facilitate phonemic and prosodic accuracy of production. However, rate reduction is not a unidimensional phenomenon, either in form or in the techniques used to achieve the reduction. Rate reduction strategies typically entail alterations in pause time and/or articulation time. Alterations of articulation time and pause time in the treatment of apraxic speakers has received little clinical verification, although its possible benefits have been alluded to by some researchers (Rosenbek, Lemme, Ahern, Harris and Wertz, 1973; Wertz, 1978). In a study by Southwood (1983) the effects of prolonged speech on the frequency of articulation errors produced by three apraxic speakers was examined. The subjects listened to a tape-recorded sample of a speaker using prolonged speech. They were then instructed to stretch out the vowel in each syllable and stretch out the words in each phrase. One of the three subjects markedly reduced the frequency of his articulation errors when instructed to use prolonged speech. The other two subjects maintained error scores at the same level as that achieved when reading at very slow rates. The results of this experiment suggest that prolonged speech may be useful in controlling speaking rate and reducing articulation errors for some apraxic speakers. The aim of the present study was to examine the effects of prolonged speech on the articulatory performance of two patients with apraxia of speech.

METHOD

Subjects. A 26-year-old female (S1) and a 24-year-old male (S2) served as subjects. S1 suffered from a left fronto-parietal embolus from the mitral valve and a left middle cerebral mycotic anneurysm. S2 suffered a left cerebral hemorrhage of the fronto-temporo-parietal lobes following a fall. The time post onset of the trauma was 6 months for both subjects.

The subjects were classified as apraxic on commonly used descriptive characteristics of their speech. S1's speech was characterized by phonemic anticipatory errors, phonemic transposition errors, and visible and audible searching for correct articulatory postures. Speech rate was reduced. Anticipatory, perseverative, and transpositional substitutions were evident in the speech of S2,exhibited by visible and auditory searching for correct articulatory postures, reduced rate, and frequent repetitions. Both subjects demonstrated no impairment on the shortened version of the Token Test (DeRenzi and Faglioni; 1978), they both presented with some residual aphasic involvement. S1 demonstrated a mild auditory memory disturbance and reduced association naming. The verbal efficiency of S2 was reduced because of mild naming deficits, and paraphasic and apraxic errors. However, both subjects produced grammatically appropriate sentences.

Both subjects were assessed via the Apraxia Battery for Adults (Dabul, 1979). S1 was considered to have mild apraxia of speech. S2 was diagnosed as having moderate apraxia of speech. Although both had received treatment prior to this study neither had received speech therapy that incorporated rate control.

Stimulus Material. Six different reading passages were used in this study. The passages were equivalent in number of words (100) and level of difficulty. The presentation of the passages during the experimental conditions was randomized to avoid the possibility of a learning effect.

Procedures. The study involved three experiments. Each experiment was dependent upon the previous experiment. The first was designed to determine if apraxic speakers could modify their reading rates and articulation errors when instructed to use prolonged speech. The second was to determine if further reducing reading rate with prolonged speech would result in a further reduction in the error responses of S1. It also sought to determine if reductions in errors generalized to spontaneous speech. The third experiment was to determine whether reductions in errors obtained by reduced speech rate could be maintained when speaking rate was systematically increased to near normal levels. (Prolonged speech was used because it allowed more stringent control over reading and speaking rates.)

Each subject was seated in a therapy room with the clinician. During instruction to prolong, the subjects were required to read a 100-word passage. As rate was systematically increased subjects were required to produce one-minute monologues. In front of the subject was a microphone 16 cm from the subjects' mouth. All subjects' responses were tape-recorded.

During systematic decreases in oral reading rate S1 was seated in front of a Visual Display Unit (VDU). A computer was programmed to display phrases of 100-word passages on the VDU at specified exposure durations which approximated the prescribed oral reading rate in words per minute. This was achieved by altering the VDU on-screen-time for each line of words. The on-screen-time for each line remained constant throughout the reading of each passage.

On-line measurements were made of error frequency and words per minute (WPM) during each oral reading and speaking occasion. Vowels and consonants were considered to be in error if they fell into one of the following categories: phoneme substitution, omission, addition, repetition, distortion, prolongation, self-correction, pause, or unintelligible. Error frequency counts were converted into percent error scores.

Reliability. Intrajudge reliability was obtained by having the experimenter rescore 50% of the speaking and reading occasions for each subject 2 months after the initial scoring. Percentage agreement scores between the first and second ratings were 98% for S1 and 95% for S2.

EXPERIMENT I

Instruction To Use Prolonged Speech

Experiment I was a preliminary experiment undertaken to determine if instructions to use prolonged speech influenced the error frequency and oral reading rate in the two subjects. A withdrawal Ai/Bi/Aii/Bii/Aiii design (Hersen and Barlow, 1976) was employed.

During the A conditions (baseline) each subject orally read a 100-word passage at his normal reading rate. In the B conditions subjects were instructed to read each word with prolonged speech. The subjects were required to prolong the vowel in each syllable and stretch out the words in each phrase. Between each reading of the passage the subject was reminded to use prolonged speech. During each experimental condition the subject read the passage six times.

EXPERIMENT II

Systematic Decreases in Oral Reading Rate

The second experiment examined the effect of prolonged speech at reduced oral reading rates on the articulatory performance of S1. The experiment determined the oral reading rate at which S1 produced maximum improvement in articulatory performance. This experiment employed a changing criterion design (Ai/Bi/Bii.....) (Hartman and Hall, 1976). In this design the effect of intervention is demonstrated by showing that behavior changes gradually over the course of the intervention phase. The required level of performance is altered repeatedly over the course of the treatment to improve performance over time.

During the A condition the subject read aloud a passage displayed on the VDU at a rate which approximated her WPM rate in the A conditions of Experiment I. The Bii condition required that the subject read a passage at a WPM rate that was 20% below the rate employed in the Bi condition. Each successive B condition involved further 20% reductions in oral reading rate.

The final phase of the experiment (Biii/Bii/Aii) involved systematic increments in rate. This was incorporated to establish whether maximum improvements in articulatory accuracy could be sustained as rate was increased to original baseline levels. Each phase of the treatment continued until an absence of a trend in the data and relatively little variability in performance was observed (Kazdin, 1982). Reductions in rate continued until no further reductions occurred in error response scores.

Generalization probes were implemented to determine if the improvement observed during oral reading with prolonged phonation transferred to spontaneous speech. After four consecutive readings of the passage the subject was required to produce a one-minute monologue. Error frequency counts and WPM scores were obtained for these probes.

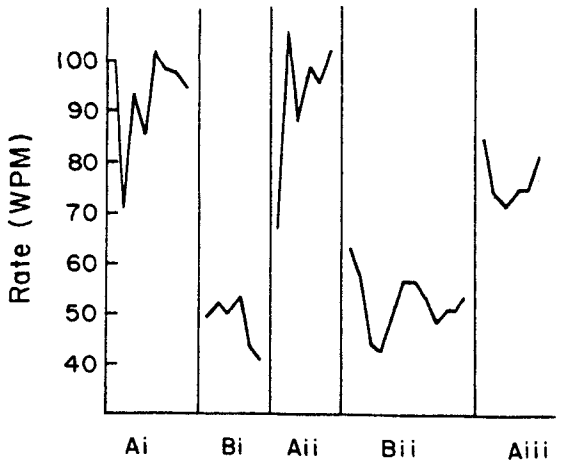
EXPERIMENT III

Systematic Increases in Speaking Rate

This experiment was designed to evaluate the efficacy of prolonged speech at reduced speaking rates as a treatment procedure for mild-to-moderate apraxic speakers. The procedure used in this experiment was similar to that used in Experiment II. A changing criterion design Ai/Bi/Bii/..../Aii (Hartman and Hall, 1976) was implemented. However the B conditions involved systematic increases in speaking rate from 30 WPM (Bi condition). During each subsequent B condition, rate was increased by 20%. A target rate criterion of +20 WPM had to be maintained during each of the B conditions. Visual feedback was provided for the subjects to ensure that speech rate was within the target range.

RESULTS

Experiment I. The results for S1 are displayed in Figure 1. S1 decreased her error scores from a mean of 13.88 during the Ai condition to a mean of 2.5 during the Bi condition. Error scores ($\bar{x}$ = 10.96) increased with the withdrawal of the prolonged speech condition (Aii) (Table 1). The reinstatement of prolonged speech (Bii condition) resulted in a further reduction in error scores ($\bar{x}$ = 1.58). The decrease in error scores during the treatment conditions (Bi and Bii) may have been due to prolonged speech and the concomittant reduction in oral reading rates. Reading rates during the A conditions were



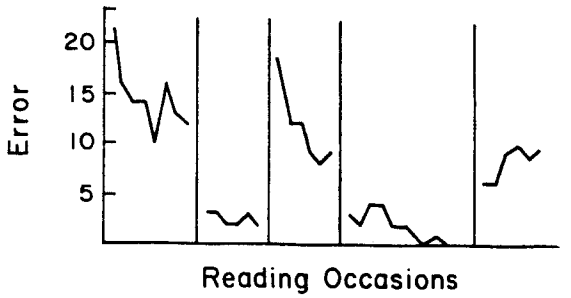
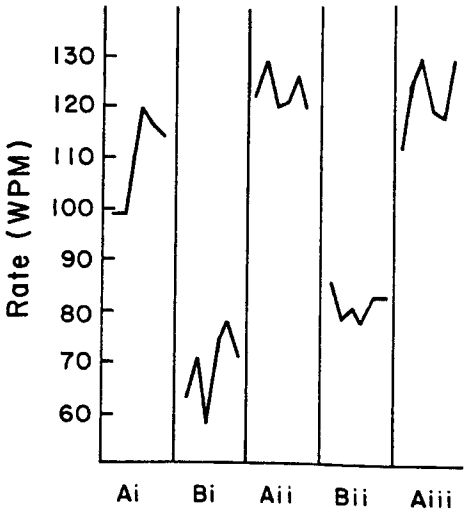


Figure 1. Percent errors and WPM produced by S1 while orally reading using prolonged speech during Experiment 1.

Subject Two



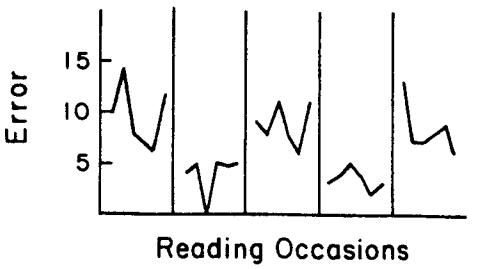


Figure 2. Percent errors and WPM produced by S2 while orally reading using prolonged speech during Experiment 1.

Ai = 91 WPM; Aii = 93 WPM; and Aiii = 76 WPM. S1 slowed her oral reading rates to a mean of 48 WPM and 52 WPM during the Bi and Bii conditions.

Table 1. Mean and range for WPM and percent error scores for S1 and S2 during Experiment I (Instruction to use prolonged speech).

	CONDITION	WPM $\bar{X}$	WPM RANGE	% ERROR $\bar{X}$	% ERROR RANGE
S1	Ai	91	70-101	13.38	10.0-15.8
	Aii	93	66-102	10.96	7.9-16.8
	Aiii	76	71- 84	7.97	5.8- 9.9
	Bi	48	41- 53	2.50	2.0- 3.0
	Bii	52	63- 42	1.58	0.0- 4.0
S2	Ai	110	99-120	8.40	6.9-14.0
	Aii	123	119-129	8.70	5.9-10.9
	Aiii	122	112-129	8.20	5.9-13.0
	Bi	69	57- 78	4.10	1.0- 4.9
	Bii	82	78- 86	3.50	2.0- 5.0

Similar results were obtained for S2 (Figure 2). This subject's baserate error scores ($\bar{x}$ = 8.4) decreased to a mean of 4.1 with the introduction of prolonged speech (Bi condition). When prolonged speech was removed (Aii condition) error scores ($\bar{x}$ = 8.7) returned to baseline levels (Table 1). The reintroduction of prolonged speech (Bii condition) resulted in a decline in his error scores to a mean of 3.7. S2 also produced marked reductions in his oral reading rate when using prolonged speech (Bi = 69 WPM, Bii = 82 WPM) compared with his baserate levels (Ai = 110 WPM, Aii = 123 WPM, and Aiii = 122 WPM). Overall the results indicate that apraxic speakers can reduce the frequency of their articulation errors when using prolonged speech.

Experiment II. The results for S1 are displayed in Figure 3. Systematic reductions in oral reading rate in conjunction with prolonged speech resulted in a marked reduction in her error response scores (Table 2). Mean error scores decreased from 13.48 in the Ai condition to a mean of 3.15 during the Bi condition. When rate was decreased to 40 WPM and 30 WPM during the Bii and Biii conditions, error scores decreased to a mean of 0.94 and 0.20 respectively. Maximum articulatory performance was achieved when the subject read at 30 WPM (Biii condition).

As the rate was systematically increased in the final phase of the experiment (Bii/Bi/Aii), a gradual increase in error scores was observed. However, in the final baseline condition (Aii) error scores ($\bar{x}$ = 3.8) remained well below the original baserate error scores ($\bar{x}$ = 13.48) despite similar oral reading rates for the Ai ($\bar{x}$ = 104 WPM) and Aii ($\bar{x}$ = 99 WPM) conditions.

Although marked improvements were obtained in the articulatory performance for this subject during oral reading, the generalization probes indicate that there was little transfer to spontaneous speaking conditions. Error scores ranged from 4.0 to 8.0 during these probes.

systematic decreases in oral reading rate and generalization probes (*) during Experiment II.

CONDITION	WPM $\bar{X}$	WPM RANGE	% ERROR $\bar{X}$	% ERROR RANGE
Ai (100 WPM)	99.94 *(120.25)	88-106 (108-139)	13.48 (6.75)	7.0-20.0 (5.0- 8.0)
Bi (50 WPM)	48.50 (114.60)	48- 50 (98-140)	3.15 (6.13)	0.0- 7.8 (4.0- 8.0)
Bii (40 WPM)	40.75 (128.23)	40- 42 (94-167)	0.94 (6.05)	0.0- 4.0 (4.3- 8.7)
Biii (30 WPM)	41.40 (135.00)	31- 32 (133-137)	0.20 (6.35)	0.0- 1.0 (5.9- 6.9)
Bii (40 WPM)	41.17 (112.00)	41- 42 (111-113)	0.17 (4.80)	0.0- 1.0 (4.1- 5.9)
Bi (50 WPM)	48.25 (122.33)	47- 49 (114-129)	1.84 (6.70)	0.0- 3.1 (6.1- 7.9)
Aii (100 WPM)	104.00 (122.33)	101-106 (112-138)	3.80 (4.60)	2.0- 7.0 (4.2- 5.1)

Experiment III. During this experiment S1 maintained error scores well below baserate levels as rate was systematically increased during the prolonged speech conditions (Figure 4).

The introduction of prolonged speech at 30 WPM (Bi) resulted in errors decreasing from a mean of 5.9 to a mean of 0.16. Error scores ($\bar{x}$ = 2.55) increased when speaking rate was increased to 102 WPM (Bvi) during the prolonged speech conditions (Table 3). At no stage during prolonged speech did her error scores return to the levels obtained during baserate (Ai). S1 was also able to maintain speaking rate (WPM) within the target range set during the prolonged speech conditions.

Table 3. Mean and range for percent error scores and WPM scores for S1 during systematic increases in speaking rate during Experiment III.

CONDITION	WPM $\bar{X}$	WPM RANGE	% ERROR $\bar{X}$	% ERROR RANGE
Ai (112 WPM)	112.11	94-167	5.91	4.0- 8.70
Bi (30 WPM)	37.00	34- 44	0.16	0.0- 2.00
Bii (44 WPM)	45.00	41- 52	0.49	0.0- 2.00
Biii (54 WPM)	56.00	48- 60	1.23	0.0- 3.00
Biv (67 WPM)	68.00	64- 74	1.10	0.0- 3.00
Bv (82 WPM)	85.00	71- 97	1.51	0.0- 3.92
Aii (113 WPM)	113.00	94-128	3.39	1.9- 6.53
Bv (82 WPM)	84.00	75- 95	2.72	0.0- 5.50
Bvi (102 WPM)	102.00	90-111	2.55	0.9- 4.00
Aiii (115 WPM)	115.00	108-121	6.03	4.3-10.62

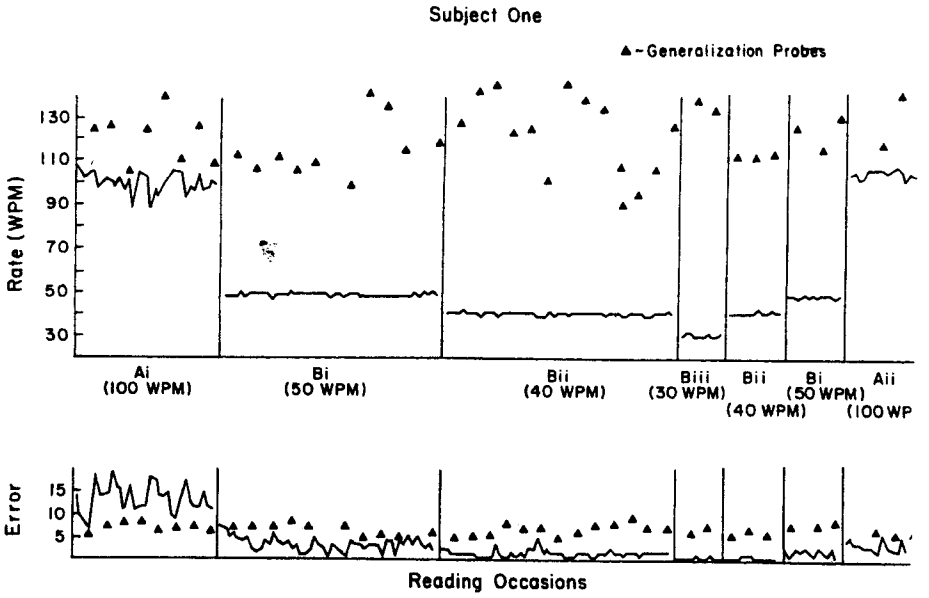


Figure 3. Percent errors and WPM produced by S1 while orally reading at systematically decreased rates using prolonged speech during Experiment 2.

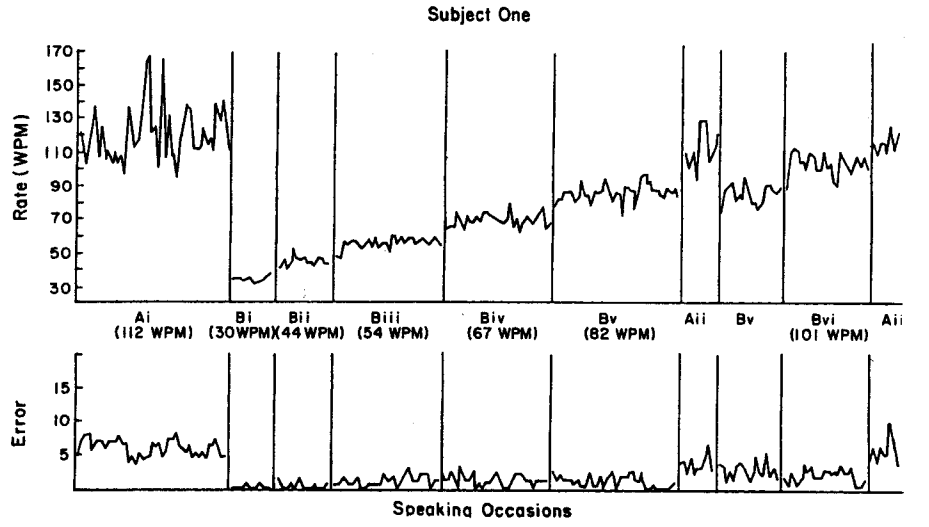


Figure 4. Percent errors and WPM produced by S1 while speaking at systematically increased rates using prolonged speech during Experiment 3.

Similar findings were also observed for S2 (Figure 5). With systematic increases in speaking rate, error scores remained well below baserate levels ($\bar{x}$ = 6.02). Errors increased from a mean of 0.61 (Bi = 30 WPM) to a mean of 1.07 (Biv = 92 WPM) during the prolonged speech conditions as rate increased. For S2 rate was not increased to the original baseline levels nor was a final baserate obtained, because the subject was discharged from the center. However, the Aii condition provides evidence that removal of prolonged speech resulted in a marked increase in error response scores (Table 4).

Although S2 maintained his error scores below baseline levels he had a great deal of difficulty maintaining control over his speaking rate. Despite this difficulty controlling his speaking rates the subject was able to maintain relatively low error scores.

Table 4. Mean and range for percent error scores and WPM for S2 during systematic increases in speaking rate during Experiment III.

CONDITION	WPM		% ERROR	
	$\bar{X}$	RANGE	$\bar{X}$	RANGE
Ai (132 WPM)	133.0	108-159	6.02	4.00- 8.40
Bi (30 WPM)	44.0	36- 55	0.61	0.00- 4.95
Bii (52 WPM)	59.0	54- 65	1.02	0.00- 3.90
Aii (162 WPM)	162.0	126-197	6.69	2.54-10.40
Bii (52 WPM)	64.0	57- 74	0.78	0.00- 1.96
Biii (73 WPM)	76.0	66- 90	1.25	0.00- 4.95
Biv (92 WPM)	99.0	89-122	1.07	0.00- 2.58

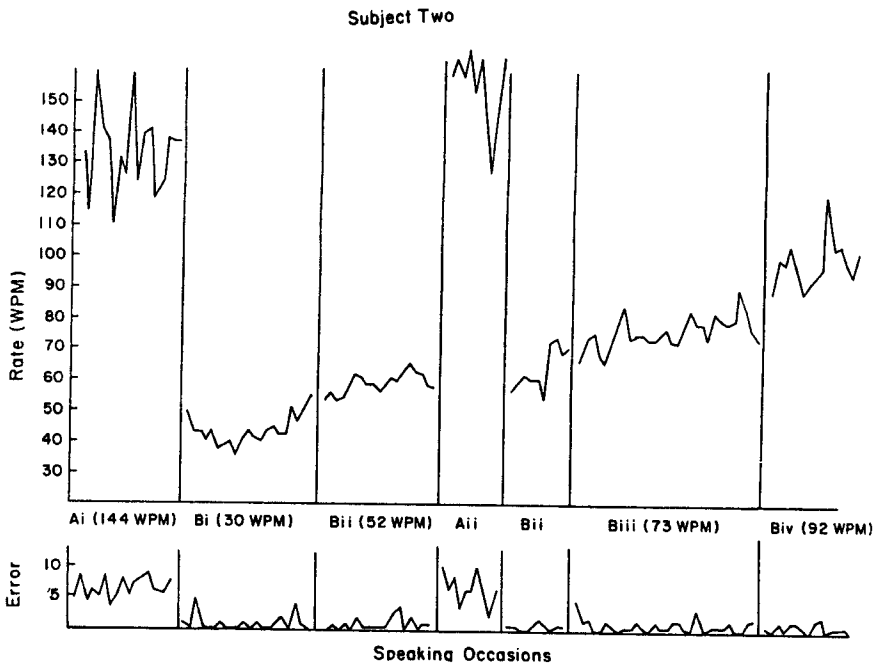


Figure 5. Percent errors and WPM produced by S2 while speaking at systematically increased rates using prolonged speech during Experiment 3.

DISCUSSION

It can be concluded that prolonged speech at reduced speech rates facilitated correct phoneme production for these two mild-to-moderate apraxic speakers. Systematic increases in speaking rate during conditions of prolonged speech resulted in some increases in error response scores. However, error scores did not return to baseline levels.

It seems that prolonged speech may be useful as a clinical technique for improving the articulatory accuracy of some apraxic speakers. However, during prolonged speech, error scores are not entirely eliminated. Also, in some of the conditions the subjects found it hard to maintain target speaking rates. To overcome these limitations it may be worthwhile to employ some contingency management techniques similar to those used during stuttering therapy (Ingham, 1983). Such procedures may include setting criterion levels for error response scores. This may allow apraxic speakers to maintain achievable levels of articulatory accuracy. It may also enable maximum improvement in error scores to be maintained as speaking rate is increased. Providing subjects with feedback about error response scores and speaking rate could prove to be valuable in assisting subjects to maintain low error response scores when rate is systematically increased. It may also improve self-monitoring skills and help to maintain improvements in articulatory accuracy. Overall, the results from this study are encouraging. However, before prolonged speech can be recommended as a viable procedure, further replication of these results with other subjects is required.

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DISCUSSION

Q: I couldn't quite keep track of this but I do remember that in the generalization probes both the oral reading rate and the error rate did not generalize. Did you look at generalization of the prolongation? Did it generalize or not?

A: No it didn't generalize at all. That was why I introduced Experiment III. It used spontaneous speech rather than oral reading.

Q: When the patient was prolonging did it make the speech bizarre? Did the patient not generalize because it sounded so unusual that the patient wouldn't use it?

A: It sounds very bizarre. It is very unnatural and that's why it didn't generalize to spontaneous speech. However, the reason why I used prolonged speech is that it does maintain control. The reason why Experiment III is included is because gradually increasing rate, but also keeping some features of prolonged speech, doesn't make it sound as abnormal. Also you can return to normal prosody as you approach near-normal speaking rates.

Q: Did you take any measures to ensure that they were actually slowing speaking rate through prolongations versus the use of increased pause time?

A: Yes. One of the measures in using prolonged speech is that they are not to have any breaks between words at all. They're supposed to run all the words together.

Q: It has been said that almost anything we do with apraxic speakers helps them. Do you have any feeling from this experience and other of your experiences that this method is perhaps better than some other things that we might do or worse than some other things that we might do?

A: I think in some ways it is a very good method for getting people to slow speech. I think one of the problems with this method is that you don't know what it is exactly that the speakers are doing when they are slowing speech. It may be that when they are prolonging they are developing their self-monitoring skills or they're developing something else, therefore it may not be the prolonged speech per se. I think it is effective but I wouldn't recommend it as the only treatment procedure. I think it may be viable for some subjects. I think that we should also consider the other side of the coin, that is, increasing rate, because one of the problems with prolonged speech is that it imposes an abnormal prosodic pattern onto subjects whose speech is already abnormal. Also, when using this procedure I think that issues like acceptability and naturalness of speech production have to be considered.

Q: Do you have any way of identifying patients who should get this method early on in their treatment?

A: Basically these subjects were 6 months post onset and they had minimal other problems. Their main problem was their apraxia. Both of them were young and very intelligent. I wouldn't consider using this with a severely apraxic subject.

Q: The technique seems to be reminiscent of the stretched speech used in precision fluency shaping programs and airflow techniques used in stuttering. I'm just curious if part of your conceptualization for using this is a thinking of apraxia of speech as being part laryngospasm of some sort.

A: This research is built on a prolonged speech therapy program that was devised by Ingham and Andrews (1973). They used this technique in a much more stringent and controlled way than in this study. However, I don't think it is overcoming a laryngospasm. These subjects didn't demonstrate that at all.

Q: I'm curious if you conceptualize apraxia more as a motoric deficit than a linguistic deficit.

A: I would consider apraxia to be more a motoric deficit and to incorporate timing problems than a linguistic deficit. I think dysfluency in general could be considered to be essentially motoric rather than linguistic. This is not to say that linguistic factors may not influence the problem.

Q: How often did you take probes and what were the discrete data points?

A: The generalization probes were taken after four consecutive readings of a passage. Each passage contained 100 words. One data point represents one reading or one speaking occasion. It doesn't represent a mean score for several occasions. For example, in one treatment occasion, depending on the speaking rate, the subject may get in 5 or 6 readings.

C: I think an interesting follow-up would be Ingham's naturalness work as a supplement to what you are doing. I think it would be a very interesting direction to go given the prolongation.

A: I'm starting to do that with dysarthric speakers and hopefully at some point can look at apraxic speakers as well.

Q: You mentioned something about feedback or giving the patients' feedback in therapy. Can you describe it?

A: The feedback that they were also given is some visual feedback of the rate that they were speaking. They had a light display of the number of syllables they were speaking and the time within which they were spoken. In spontaneous speaking conditions they had no feedback except that they were reminded to use prolonged speech. I think some sort of visual feedback in the initial stages might help to maintain the gains they have already made or are making. You would then probably have to withdraw that feedback at some point.