Rehearsal as a Self-Correction Strategy for Patients with Apraxia of Speech

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Many of the intervention techniques which have been found effective for patients with apraxia of speech require imitation of the clinician's speech model. In his comprehensive review of treatment of apraxia of speech, Rosenbek (1978) pointed out that despite its time-honored usefulness in therapy, imitation is not the same as propositional speech. Consequently the patient must be guided toward self-generated speech by a system of gradually weakened cues. One method of fading cues is the progressive lengthening of the interval between stimulus and response.

A consideration in the use of delayed response is whether or not to have the subject rehearse the target word during the delay interval. Some writers (Deal and Darley, 1972; Johns and Darley, 1970) have suggested that silent or spoken rehearsal might be beneficial. Others (Warren, 1977; LaPointe and Horner, 1976) have questioned the value of rehearsal. Deal and Darley found that requiring delay intervals of 0, 3 and 6 seconds made no significant difference in the phonemic accuracy of imitated words. Noting that some of their subjects spontaneously rehearsed, they proposed that instructions to rehearse might improve responses. Warren (1977), however, found no advantage for silent rehearsal over spoken repetition in long-term retention of phonemes. Johns and Darley observed that a series of three repetitions of a word seemed to facilitate responses, but LaPointe and Horner (1976) described a trend toward deterioration over 10 repetitions.

Our clinical observation of certain apraxic patients suggested that the accuracy of target words may indeed improve over several repetitions and then deteriorate with further repeating. Moreover, these patients seemed to be able to imitate words more accurately when the length of delay interval and the number of repetitions were controlled by the patients themselves. Since it has been suggested that apraxic patients usually have relatively intact self-monitoring skills and auditory discrimination ability, we hypothesized that allowing the patient to control rehearsal strategies would facilitate the use of auditory feedback, and thus improve the accuracy of response and support the transfer from imitation to propositional speech. In contrast, clinician control would not permit such facilitation and comparatively poor performance could be anticipated. The purpose of this study, therefore, was to compare the effect of clinician control to that of patient control of the length of response delay and the number of rehearsals in a word imitation task.

METHOD

Ten subjects participated, eight males and two females, ranging in age from 36 to 72 years with a mean age of 57.8. Nine had had left hemisphere CVA's and one had suffered closed head trauma. The range of months

post-onset was from 3 to 35 with a mean of 14.2. Table 1 is a summary of subject data. Subject selection was based on diagnosis of apraxia of speech without significant impairment of auditory comprehension or reading comprehension as indicated by a mean score of 12 or better on subtests V, VI, VII, and X of the Porch Index of Communicative Ability. Apraxia of speech was diagnosed from subjects' performance on a number of verbal tasks, including diadokokenesis, single word imitation and spontaneous speech. All subjects passed a hearing screening.

Table 1. Subject data summary.

Subject	Age	Sex	MPO	Etiology
1	58	Male	22	CVA
2	52	Male	4	Head Trauma
3	58	Male	5	CVA
4	58	Male	13	CVA
5	57	Male	17	CVA
6	72	Male	35	CVA
7	36	Male	3	CVA
8	53	Female	11	CVA
9	67	Female	4	CVA
10	67	Male	28	CVA

The stimulus words chosen for the study consisted of 30 picturable, one-syllable nouns with high frequency of occurrence in English. All English sounds were equally represented within the limitations of the language. Ten of the words contained consonant blends in initial or final position.

Each subject was presented with the series of 30 words to be imitated following five different instructions as to delay and rehearsal strategies. The four experimental conditions were (1) clinician-controlled delay, (2) clinician-controlled rehearsal, (3) patient-controlled delay, and (4) patient-controlled rehearsal. In the first, a fixed interval of 3 seconds was imposed between stimulus and response. The second required four spoken rehearsals before the response. In the third and fourth conditions, the patient determined the interval of delay and the number of rehearsals, respectively. A control condition requiring an immediate response to the spoken stimulus was also included. The order of presentation of the five tasks was randomized.

For each task a pretest of five training words was used to assure that the subject understood the instructions. Then each of the 30 test words

was spoken by the examiner immediately after presentation of a picture representing the stimulus word. Subjects' responses were tape-recorded, phonetically transcribed, and then scored.

The scoring system was derived from Lecours and Lhermitte's (1969) method of calculating paradigmatic distance. They used five distinctive features, assigning a score of "1" to differences in each to arrive at the distance between the target sound and the realized sound. A plus sign was used to indicate congruent features. For the present study, correct sounds were scored "+" and errors assigned a paradigmatic distance of 1, 2, or 3 with one point each scored for errors of place, manner and voicing for consonants. Vowel distortions, sounds perceived as at or near the boundary of the target, were scored "1." Diphthongization of vowels was scored "2" and substitution of other English vowels was scored "3." Addition of an intrusive vowel or consonant which suggested an error in timing rated a "1." Addition of a consonant which was more easily explained as a substitution of a consonant blend for a single sound was assigned a "2" if the paired consonant was correct and "3" if the paired sound was incorrect. Omitted phonemes were scored "3" and failure to respond, stereotypes, and verbalizations which were not an attempt at the task were scored as omission of all phonemes for that target word. Table 2 includes a sample of subject responses with the scores derived for each.

Table 2. Examples of subject responses and scores assigned to each.

Target Word	Response	Total Score
lɪf	lɪt	
	++2	2
kɪŋ	stɪŋ	
	3++	3
nɛst	dɛnt	
	1+2+	3
mɑp	bɛk	
	131	5
wɛks	tʌk-	
	33+3	9

RESULTS

Application of a Friedman Two-Way Analysis of Variance revealed a significant difference ($p < .01$) in the phonemic accuracy of words produced under the various delay and rehearsal conditions. Pair-wise comparisons

between conditions using a Wilcoxon Matched Pairs Signed Ranks Test (with adjustment of alpha level for post-hoc comparisons) showed that the 10 apraxic subjects were able to imitate words with significantly greater accuracy after a self-determined number of rehearsals than after no rehearsal or after a clinician-determined, fixed number of rehearsals. Word imitation was significantly better ($p < .01$) after patient-controlled rehearsal than after a clinician-controlled silent interval. Differences among the other conditions were not significant, although a trend toward improvement after patient-controlled delay was noted. The data are summarized in Table 3.

Table 3. Summary of paired comparisons showing mean error scores and values of t for the five conditions.

Conditions	Mean Error Score	Condition			
		2	3	4	5
1 Immediate	51.0	27.5	16.5	9.0	0.0[a]
2 Clinician-controlled delay	69.9		22.0	14.0	1.0[a]
3 Clinician-controlled rehearsal	44.7			11.5	0.0[a]
4 Patient-controlled delay	38.0				11.0
5 Patient-controlled rehearsal	30.4				

[a]Significant at the .01 level.

DISCUSSION

Examination of the data showed that a series of five repetitions of words produced some improvement in accuracy over the no-rehearsal method for five of the 10 subjects. However, nine of the 10 improved when allowed to control the number of rehearsals themselves and the tenth did equally well in the no-rehearsal and self-determined rehearsal modes. It was observed that subjects seldom chose to employ more than three rehearsals, and often stopped rehearsing after an initial, correct trial of a word. They

usually did not go beyond their best response to a less accurate one, although in rare extended rehearsals the last several trials were often equally accurate.

The results of this study support the hypothesis that apraxic patients have a capacity for evaluation of their own speech productions. They tend to improve in phonemic accuracy over successive repetitions when given the opportunity to control the number of these repetitions themselves. The trend toward deterioration over 10 repetitions noted by LaPointe and Horner (1976) and the lack of improvement beyond four rehearsals in the present study suggest that excessive repetitions may result in fatiguing of either perceptual or production systems. That is, the deterioration may reflect a form of either the verbal transformation phenomenon, which occurs when normal subjects listen to multiple repetitions of a stimulus word; or the phonemic transformation effect seen in normal speakers who are asked to repeat tongue twisters such as "toy boat" several times.

It would seem that modification of apraxia therapy techniques to include patient-controlled rehearsal may improve the phonemic accuracy of their responses and may enable the patient to move more quickly to self-generated cueing of propositional speech. For example, we have used traditional imitation drills in which the clinician presents a speech model, the patient imitates and the clinician provides feedback followed by a step in which the patient evaluates his or her own productions. When the patient has developed and demonstrated sufficient skill at self-evaluation, spoken rehearsal is introduced, emphasizing patient control. Our subjects are instructed as follows: "Practice saying these words. First I'll say each one. You practice it out loud until you feel it is right or until it is the best you can do." Once an appropriate level of success is reached, the same approach is applied to a picture-naming task. Finally, the patient is encouraged to employ covert rehearsal during self-determined delay. We use the following instruction: "I want you to say these words. First I'll say each one. When you feel you are ready, then you say it. Be sure to wait until you feel you can say it right." Further study is, of course, required to evaluate the effectiveness of a period of training in these rehearsal techniques.

Findings in the present study suggested that the ability of apraxic subjects to benefit from delay and rehearsal strategies was influenced by a number of variables not measured or controlled for in this investigation. These include intactness of internal speech, intactness of the auditory feedback system, adequacy of immediate and short-term memory, severity of phonological impairment and severity of concomitant aphasia. A future study might investigate all or some of these by means of a measure of internal speech, such as a rhyming or syllabification test, a test of auditory memory requiring immediate and delayed responses, and statistical controls for the severity of the phonological impairment and the aphasia.

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