CHAPTER

15

Sentence Comprehension and Repetition in Conduction Aphasia: Results of Parallel Testing

Robert C. Marshall
Sandra I. Neuburger
David S. Phillips

Individuals with conduction aphasia have captivated aphasiologists' interest for more than a century. The behavioral hallmark of this syndrome is a disproportionality of impairment between the patient's auditory comprehension and repetition performance (Goodglass, 1981; Goodglass and Kaplan, 1972). Typically, comprehension is spared or minimally impaired, whereas repetition is more severely compromised (Brown, 1972; Damasio and Damasio, 1980; Gardner and Winner, 1978; Geschwind, 1971; Green and Howes, 1977).

Studies of conduction aphasia have focused primarily on repetition. Sometimes overlooked is the fact that repetition tests the entire "circuit" for reception and production of verbal messages from the primary auditory cortex through the motor cortex for speech (Brookshire, 1986; Geschwind, 1971). While studies of conduction aphasia have shown subjects' comprehension to be superior to repetition, comprehension in conduction aphasia is not always flawless (Benson et al., 1973; Caramazza, Basili, and Kohler, 1981; Green and Howes, 1977). There is reason to suspect that certain subjects' inability to process completely the stimulus they are to repeat may influence repetition performance. Further study of these processing deficits and their relationship seems warranted.

This study provides information on the sentence comprehension and repetition abilities of conduction aphasic subjects. It differs from previous studies in its use of a parallel testing format (Darley, 1982). This involves the administration of tasks that compare performances on identical items in different stimulus modes. Parallel testing of sentence comprehension and repetition is particularly troublesome because the former usually involves asking the patient to point to pictures or to follow commands, whereas the latter requires the reproduction of novel spoken utterances such as, "The phantom soared across the foggy heath." We dealt with this problem by selecting a sentence-comprehension task using pictures that also provided us with relatively novel stimuli that also would be appropriate for assessment of repetition. We asked three questions:

1. Does the performance of conduction aphasic subjects differ on parallel sentence comprehension and repetition tasks?
2. Is there a relationship between sentence comprehension and repetition performance in conduction aphasia?
3. What stimulus attributes affect repetition performance in conduction aphasia?

METHOD

SUBJECTS

Ten conduction aphasic patients served as subjects. They were administered the Boston Diagnostic Aphasia Examination (BDAE) (Goodglass and Kaplan, 1972), the Porch Index of Communicative Ability (PICA) (Porch, 1981), and clinical and neurologic examinations. Computed tomography (CT) scans implicating involvement of the posterior language zones of the left hemisphere were available for eight of the subjects. Diagnoses of conduction aphasia were made by the examining speech-language pathologists on the basis of the auditory comprehension and repetition tests of the BDAE, PICA, neuroradiographic data, and other clinical measures. Subjects are described in Table 15-1.

TESTING

Sentence comprehension was assessed with the Auditory Comprehension Test for Sentences (ACTS) (Shewan, 1979). The ACTS contains 21 sentences. These are read by the examiner to the patient, who points to one of four pictures that represents the meaning of the sentence. The ACTS stimuli were constructed to determine the influences of length, vocabulary level, and syntactic complexity on sentence comprehension (Shewan, 1979; Shewan and Canter, 1971). Length is dependent on the number of critical items and total number of syllables in the utterance. Three levels, designated, L1, L2, and L3, contain different numbers of critical items and numbers of syllables. Vocabulary difficulty, designated as V1, V2, and V3, is defined in terms of frequency of word usage based on the general count of Thorndike and Lorge's 30,000 word list (Thorndike and Lorge, 1944). Finally, the ACTS deals with three levels of syntactic complexity, S1, S2, and S3. These are determined by the presence or absence of features such as optional transformations, negatives and passives, and the use of past or present tense. The ACTS is constructed so that one of the three parameters, length, vocabulary, or syntax, is varied systematically while the other two are held constant. This process yields seven possible combinations, examples of which are given in Appendix 15A.

Sentence repetition, hereafter designated as ACTS-R, was assessed using the ACTS stimuli. Instructions were as follows: "I am going to read you some sentences one at a time. After I read each sentence, I want you to repeat it word for word. I will not be able to repeat the

TABLE 15-1. CHARACTERISTICS OF APHASIC SUBJECTS: AUDITORY COMPREHENSION (AC%)—PERCENTAGE CORRECT ON AUDITORY COMPREHENSION SUBTEST OF BDAE; REPETITION (REP%)—PERCENTAGE CORRECT ON HIGH AND LOW PROBABILITY SENTENCES ON THE BDAE

Subject	*Age/sex*	*Months post onset*	*Etiology*	*CT site, left hemisphere*	*BDAE*		
					PICA%	AC%	REP%
1	55/M	17	Cerebral Vascular Accident	Tempero Parietal	61	81	40
2	46/M	151	Cerebral Vascular Accident	Parieto Occipital	88	93	57
3	66/M	7	Cerebral Vascular Accident	Occipital	—	100	60
4	63/M	25	Cerebral Vascular Accident	Parieto Occipital	74	75	43
5	36/M	192	Hemorrhage	—	82	78	55
6	57/M	3	Cerebral Vascular Accident	Parietal	79	94	73
7	65/F	106	Cerebral Vascular Accident	—	87	90	80
8	65/M	2	Cerebral Vascular Accident	Occipital	—	100	73
9	63/M	2	Hemorrhage	Parietal	83	78	33
10	55/M	11	Cerebral Vascular Accident	Temporal	85	85	47

sentence for you a second time. Listen carefully and tell me what you can." Half the subjects were given ACTS-R first, and half received the ACTS first.

SCORING

The ACTS and ACTS-R responses were scored plus or minus. To provide a more precise analysis of factors that might affect subjects' repetition performance, the tape-recorded ACTS-R responses also were scored using a weighted scoring system. Exact repetitions of the examiner's utterance were scored as 2. Minor flaws in repetition in which the meaning of the sentence was clearly preserved were scored as 1. Severe repetition errors when the subject did not respond, omitted a portion of the sentence, or added words so that meaning was altered were scored 0. Two examiners scored responses from the tapes independently for 8 of 10 subjects. The examiners agreed on 88.7 percent of the judgments. Disagreements were resolved by mutual agreement upon rescoring.

RESULTS

COMPREHENSION VERSUS REPETITION

Figure 15-1 summarizes subjects' ACTS and ACTS-R scores. The group mean for the ACTS was 18.2 ($SD = 2.7$); the group mean for ACTS-R was 4.2 ($SD = 3.7$). A t-test (Winer, 1971) for statistical significance between the two means showed subjects to have significantly higher ACTS than ACTS-R scores ($t = 12.90$, $df = 9$, $p > 0.001$).

RELATIONSHIPS AMONG COMPREHENSION AND REPETITION SCORES

Pearson r correlations (Winer, 1971) were computed for ACTS and ACTS-R sets of scores. When nonweighted ACTS-R scores were employed, a Pearson product correlation of .455 ($p < .10$) for a one-tailed t-test was obtained; when weighted ACTS-R scores were used, the Pearson r correlation was .429 ($p < .15$) for a one-tailed t-test. Neither correlation was statistically significant (.05).

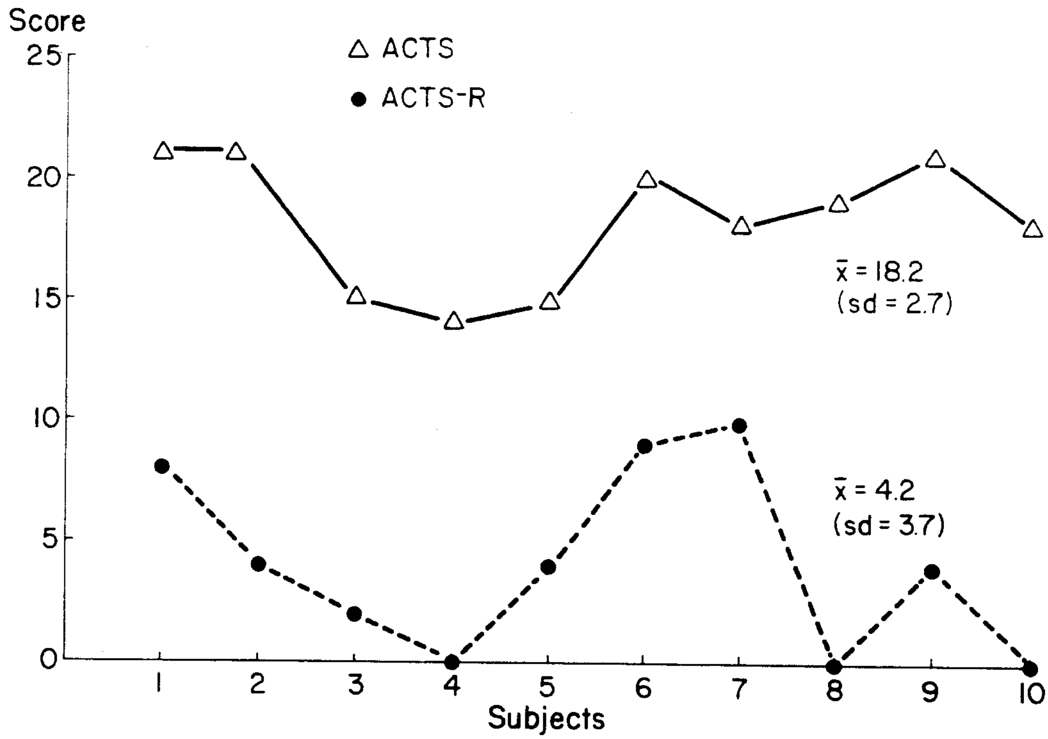

Fig. 15-1. ACTS and ACTS-R scores for conduction aphasic subjects.

Fig. 15-2. Weighted ACTS-R scores and group means for ACTS sentence types on ACTS-R task. Maximum score for each sentence type is 6.

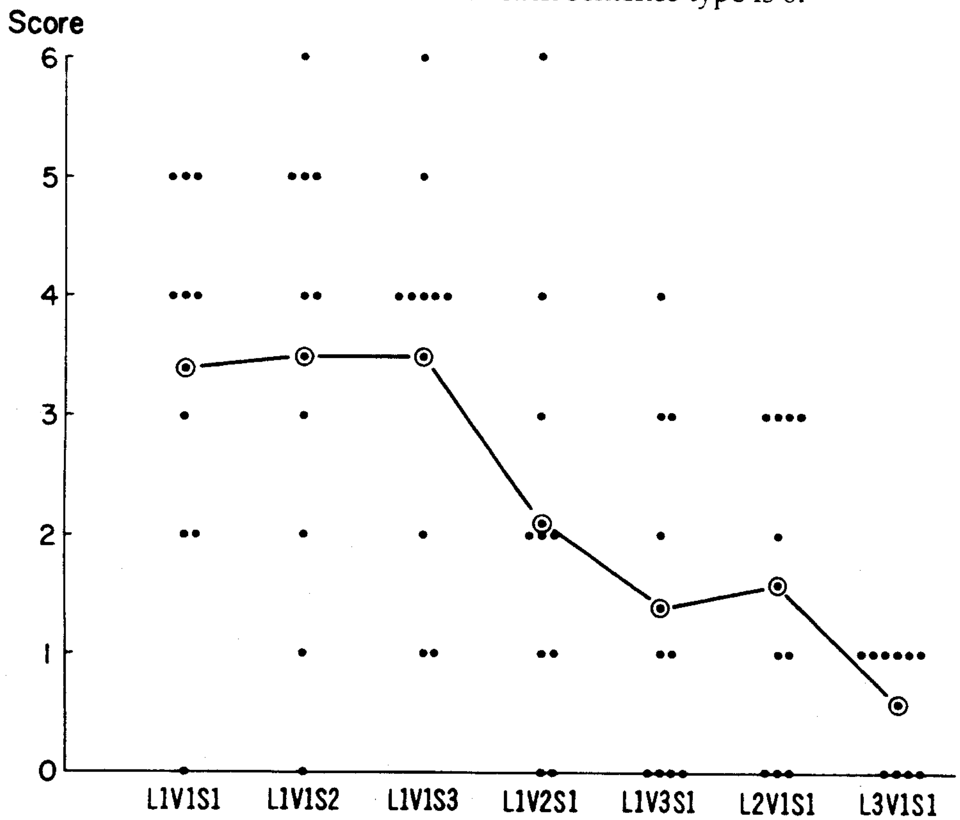

TABLE 15-2. RANK ORDERING OF SUBJECT MEANS FOR THE ACT-R AND SUMMARY OF NEWMAN-KEULS TESTS

	Sentence type						
	L3V1S1	L1V3S1	L2V1S1	L1V2S1	L1V1S1	L1V1S2	L1V1S3
Mean	0.60	1.40	1.60	2.10	3.40	3.50	3.50

Note: Any two means not underscored by the same line are significantly different.

INFLUENCE OF SENTENCE TYPE ON REPETITION

Figure 15-2 provides the weighted ACTS-R scores for individual subjects and group means for the seven sentence types. To determine if subjects' ACTS-R scores differed for the seven sentence types, a one-way ANOVA with repeated measures using the sum of the subject's three scores for each sentence type was conducted. Results revealed subjects' ACTS-R performance for the various sentence types to differ significantly ($F = 14.11$, $df = 6,54$, $p < .01$). Table 15-2 provides a rank ordering of group means for ACT-R performance. A Newman-Keuls tests (Winer, 1971) (see Table 15-2) to determine which of the ACTS-R means were statistically different revealed that mean scores on the longer sentences (L3V1S1, L2V1S1, and for those sentences containing more difficult vocabulary items, L1V3S1) were significantly lower than all other means but not from each other.

DISCUSSION

As expected, the conduction aphasic subjects in this study did better on the ACTS, a comprehension test, than on the ACTS-R, a repetition test, using identical stimuli. While this finding was anticipated on the basis of prior research, the sentence-comprehension data for the group fill in a gap with respect to other aphasic groups, since Shewan (1979) did not provide data on the ACTS performance for patients with conduction aphasia. Table 15-3 provides ACTS mean scores and standard deviations for Shewan's normal subjects, anomic, Broca's, and Wernicke's groups and the present sample. It can be seen that our sample, while smaller

TABLE 15-3. ACTS MEAN SCORES AND STANDARD DEVIATIONS FOR APHASIC AND NORMAL SUBJECTS

Group	*N*	*Mean*	*SD*
Normal	30	20.07	1.17
Aphasic:			
Conduction*	10	18.20	2.70
Amnestic	30	14.83	4.02
Broca's	30	12.53	3.97
Wernicke's	30	9.73	4.22

*Scores for the present sample; all other data taken from Shewan (1979).

than Shewan's groups, performed substantially better than all aphasic groups studied but not as well as Shewan's normal subjects.

We examined the relationship between sentence comprehension and repetition. There was a trend for subjects with lower comprehension scores to also manifest lower repetition scores, but Pearson r correlations for ACTS and ACTS-R scores, both plus/minus and weighted, were low (.455 and .429) and were not statistically significant.

Analysis of the ACTS-R weighted scores permits some speculation about the factors underlying the sentence-repetition problems in this sample of patients. Subjects had the most difficulty repeating the longer sentences; they also had more difficulty with constructions containing infrequently used words (e.g., "rodents," "deluge," "attire"). The syntactic complexity of the ACTS had the least influence on repetition. When syntactic complexity was varied, subjects often retained the meaning of the sentence but not its exact wording. This finding is in agreement with that of Hanson (1976), who found that nonaphasic subjects asked to make same or different judgments on pairs of active and passive sentences separated in time and differing only in terms of grammatical structure had a higher percentage of meaning-preserved responses than did aphasic subjects and that aphasic subjects with higher recognition scores made more meaning-preserved responses than subjects with lower recognition scores.

As stated earlier, the primary factor affecting repetition was sentence length. This result supports the auditory-verbal short-term memory (STM) deficit hypothesis initially advanced by Warrington and Shallice (1969) and recently expanded on by Caramazza, Basili, and Koller (1981) as a primary influence on repetition performance in conduction aphasia.

Lastly, it should be pointed out that the subjects in this study made few paraphasic errors. Most made paraphasic errors in speech tasks, including repetition, earlier in their courses of improvement, but at the time of this study these errors were not frequent. It is possible that hypotheses other than the auditory-verbal STM deficit might be advanced to account for the repetition problems of these conduction aphasic subjects. Among these are the decoding deficit model advanced by Strub and Gardner (1974), in which the patient is impaired in his or her selection of appropriate phonologic forms, and the encoding deficit hypothesis of Tzortzis and Albert (1974), in which the patient has difficulty transforming abstract acoustic information into the phonologic forms that guide the phonetic and articulatory mechanisms of speech output. The fact that subjects also had difficulty with the ACTS-R constructions containing infrequently used words may be accounted for by either of these hypotheses.

Unfortunately, like any sample of aphasic individuals, regardless of what you choose to call them, individual subjects reflected variability. And the most practical way of explaining the unique disassociation among repetition and comprehension remains that the reasons underlying a patient's failure to repeat a spoken utterance are multiple and as yet not completely understood.

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APPENDIX 15A

Descriptions of ACTS parameters of length, vocabulary level, and syntactic complexity and examples of ACTS stimuli.

Length. Defined in terms of the number of critical items (content words essential to the understanding of the sentence) and syllables in the sentence.

L1: Three critical items and seven syllables ("The people arrived by train").

L2: Five critical items and 11 syllables ("A large crowd is gathering at the old church").

L3: Seven critical items and 15 syllables ("The old farmer leads the white horses from the house to the road").

Vocabulary Level. Defined in terms of frequency of word usage in *Teachers' Workbook of 30,000 Words* (Thorndike and Lorge, 1944).

V1: Most frequently used 1000 words ("The girl is reading a book").

V2: 25 to 35 occurrences per million words ("The tailor mends the jacket").

V3: 1 to 15 occurrences per million words ("The wolves pounced on the poultry").

Syntactic Complexity. Defined in terms of use of affirmative and negative, present or past tense, and presence of optional transformation within sentence.

S1: Simple active affirmative declarative sentence containing no optional transformation ("The dog is fighting the cat").

S2: Sentence with one optional transformation containing either the negative or the passive ("The dogs are not chasing cats").

S3: Sentence containing two transformations with both the negative and the passive ("The milk was not drunk by her").