A Study of Repetition in Aphasic Patients

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The ability of the aphasic patient to repeat a message is a capacity of considerable diagnostic value. While it is well known that certain aphasic groups (e.g., transcortical aphasics) repeat better than other groups (e.g., conduction aphasics), possible qualitative differences among the groups have not been subjected to analysis. To secure information on repetition profiles in various aphasic subgroups, a test consisting of 11 types of items, presented under conditions of both immediate and delayed recall, was administered to eight groups of aphasic patients. The results documented a significant difference across aphasic groups, one related to site of lesion but not to severity of comprehension defect. Performance proved to be a joint product of the length and the meaningfulness of the stimulus items. The delayed condition aided Broca’s aphasics and impeded anemic aphasics; in addition, nonsense syllables proved to be easier on immediate recall, while meaningful stimuli, particularly those which were number related, were relatively easier on delayed recall. Finally, sound errors were more likely to be made by Broca’s and “mixed anterior” aphasics, while meaning errors were particularly prominent among conduction aphasics. These results are discussed in terms of the mechanisms which may mediate repetition in aphasic patients.

The capacity to repeat is regularly tested in aphasic patients. Such routine testing occurs not only because repetition is a readily isolable and discrete linguistic capacity, but also because this seemingly mundane activity has proved of considerable diagnostic value (Benson & Geschwind, 1974; Brown, 1972; Goldstein, 1948; Luria, 1970). Relatively spared repetition capacity, even in the face of comprehension deficits, is the hallmark of the transcortical aphasias; severe difficulties in repetition, against a background of relatively spared comprehension and reasonably fluent spontaneous speech, is the defining characteristic of conduction aphasia. In addition, the kinds of errors made in repetition—literal (or phonemic) paraphasias found in conduction aphasics and semantic (or verbal) paraphasias found, for instance, in certain anomic aphasics—present additional evidence which may prove useful in classification and rehabilitation.

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Given the importance of repetition performance, there has been considerable speculation about the mechanisms involved in normal repetition and the possible means by which these mechanisms may have been spared or impaired in aphasia. Some accounts focus on linguistic factors at the phonological, syntactic, or semantic level (Davis, Foldi, Gardner, & Zurif, 1977; Dubois, Hécaen, Maufras duChatelier, & Marcie, 1964; Martin & Rigrodsky, 1974; Martin, Wasserman, Gilden, Gerstman, & West, 1975; Strub & Gardner, 1974); others focus on anatomical factors (Benson, Sheramata, Bouchard, Segarra, Price, & Geschwind, 1973; Geschwind, 1971; Kinsbourne, 1972); still others seek to account for deficits in terms of cognitive or mnemonic considerations (Tzortzis & Albert, 1974; Warrington & Shallice, 1969). While these descriptions have suggested the variety of factors which may affect repetition performance in aphasia, they have not clarified the relationships among the repetition performances of various aphasic groups on different kinds of item types. Indeed, there is little, if any, discussion in the aphasiological literature of whether the differences in repetition ability are qualitative or simply quantitative ones.

An intensive investigation of the dimensions of repetition in aphasic patients should take into account a number of issues. To begin with, it is important to test all types of aphasics and to sample a variety of item types which differ from one another systematically in length, part of speech, category of knowledge (e.g., terms related to number), and degree of meaningfulness (e.g., nonsense syllables). Next, repetition capacity needs to be tapped under at least two conditions: immediate repetition, in which the kind of automatic "echoing" characteristic of transcortical aphasics can be manifest (cf. Geschwind, Quadfasel, & Segarra, 1968; Stengel, 1936; Whitaker, 1976), and delayed (unfilled) repetition, in which the patient has ample opportunity to process the stimulus for meaning, to rehearse its components, and to exhibit the kind of "conduit d'approche" often observed in conduction aphasia.

Finally, the performances of patients need to be evaluated not only in terms of absolute correctness but also in light of various error types. A test battery devised along these lines should provide information about the similarities (and differences) in repetition performances among the major subgroups of aphasics. More importantly, it should illuminate the nature of repetition in those patient groups in which its status is of critical importance—conduction aphasics and transcortical aphasics. These groups differ both in the site of the lesions giving rise to their disorders and in their overall performance on tests of repetition. The various steps undertaken here should permit a determination of whether the gross differences in overall performance entail, as well, qualitative differences in performance as a function of item type, condition of presentation, and kind of errors.
METHOD

Subjects. Subjects were all right-handed patients at the Boston Veterans Administration Hospital who had suffered left hemisphere lesions. The site of lesion was ascertained by a variety of indexes, including EEG records, surgeons' reports, clinical signs such as presence of hemiplegia, field defects, etc., and brain or CAT scans, the latter measures being available in nearly all cases. In addition to blocking by site of lesion (anterior vs. posterior), patients were classified in terms of traditional aphasiological syndromes. These classifications were based on the consensus reached by the neurological staff of the hospital after an extensive examination. The criteria used were those of Goodglass and Kaplan (1972); but given the focus on repetition, an additional distinction was made between transcortical sensory aphasia and a mixed transcortical (or isolation) syndrome (cf. Goldstein, 1948; Whitaker, Leventer, & Garnsey, 1976). Of the 44 patients tested, 17 were anterior aphasics (four Broca's aphasics with good comprehension, seven aphasics with anterior lesions and moderate comprehension loss, designated hereafter as "mixed anterior" aphasics, and six with transcortical motor aphasia); 14 were posterior aphasics (six Wemicke's, four anemic, and four transcortical sensory aphasics); 1 patient had a mixed transcortical or isolation syndrome; and 12 were conduction aphasics.

Materials. The test consisted of 79 stimulus items which patients were asked to repeat. Eleven types of items were featured: 12 letters, 6 consonant-vowel (CV) monosyllables (e.g., "bah"), 11 one-syllable nouns, 5 one-digit numbers, 10 two-digit numbers, 5 three-digit numbers, 4 percentages, 4 monetary sums, 4 fractions, 4 two-syllable nonsense words (e.g., "hortah"), and 12 "grammatical" words consisting of articles, conjunctions, and prepositions. The mean number of syllables in each of these item types was as follows: CVs, nouns, and one-digit numbers—1 syllable; "grammatical" words—1.25 syllables; letters—1.27 syllables; nonsense words—2 syllables; fractions—2.25 syllables; two-digit numbers—3 syllables; percentages—5.5 syllables; and money—8 syllables. These items were randomly intermixed and their order of presentation was counterbalanced across subjects.

Procedure. All items were read aloud by an experimenter and subjects were asked to repeat each one in turn. Responses were recorded on tape and transcribed for later analysis. The test was divided into two parts and each patient participated in both conditions. In the Immediate condition, patients were instructed as follows: "I'm going to say some things and I want you to say exactly what I have said, right after I say it." In the Delayed condition, patients were required to wait for 3 sec after hearing the item before attempting to repeat it. They were told: "I'm going to say some things and I want you to say exactly what I have said, but wait until I point my finger at you." If a patient failed to wait for the requisite 3 sec, the particular item was read again and a new response was elicited.

Sample practice items introduced the notion of immediate and delayed repetition for each condition, respectively, and the test was not begun until the subject displayed adequate understanding of the task. Half of the patients received the Immediate condition first and half received the Delayed condition first. The two conditions were administered on separate days but within 10 days of each other.

Scoring. In order to capture the full range of responses elicited, both a quantitative scoring system and an analysis of errors were undertaken. The purpose of the quantitative system was to define three levels of competence in repetition; accordingly responses were scored as either 2, 1, or 0. A score of 2 was assigned to five kinds of response:

(1) those which were perfectly correct on the first attempt;
(2) those which were erroneous on the first try but which the subject immediately corrected on his own initiative;
(3) literal paraphasias (defined as no more than one phonemic change per syllable) when the intended target was clear;
(4) errors of articulation produced by dysarthric anterior patients when the intended target was clear; and
(5) in the case of numerical items, the separate enumeration of each digit within a multidigit item (e.g., "one nine nine").

The following responses, which reflected a level of accuracy judged to be lower, received a score of 1.

(1) verbal paraphasias (defined as the production of a word in the same category as the target item), e.g., "cat" for dog; in the case of numerical items, the production of a number either within 10 digits of the target number or the production of a number with all digits correct except one; or, in the case of letters, the production of a different letter;
(2) elaborations (e.g., "cats" for cat);
(3) simplifications (e.g., the omission of a syllable, such as "forty-three cent" for 43%);
(4) in the case of numerical items, the reversal of the order of digits.

Responses which were assigned a score of 0 consisted of the following types of errors:

(1) no response given;
(2) responses which were either completely or to a large extent garbled and unintelligible;
(3) repetition of the opening sound only;
(4) responses which transformed a nonsense syllable, phoneme, letter, or number into a "real" word (e.g., "sauce" for the letter S);
(5) perseverations (defined as the repetition of a response made to a stimulus within three items prior to the target stimulus);
(6) responses which were perfectly correct English words but which bore no discernible relation to the target items (e.g., "tea" for boat).

Individual responses were sometimes characterized by more than one type of error. In such

![Graph](image-url)

**Fig. 1.** Percentage correct repetitions for each patient group across all item types on the Immediate and Delayed conditions.
cases, if the errors made all belonged to one scoring category (that is, they all either deserved a score of 1 or of 2), then the score for the item was unaffected. However, if a response consisted of both 1 and 2 type errors, the item received the lower score.

The scores for each response were summed to yield a total score for each item type. In order to correct for the different number of items within each item type, scores were then converted into percentages.

In order to facilitate an analysis of errors, incorrect responses were also coded as either sound errors, meaning errors, or other errors. Sound errors consisted of literal paraphasias, elaborations, simplifications, and articulation errors. Meaning errors consisted of verbal paraphasias. All other errors were classified as "other." Once again, the number of each kind of error made for each item type was then converted into a percentage.

**RESULTS**

A series of three-way Group x Condition x Item Type repeated-measures analyses of variance was performed on the scores calculated according to the method described above, as well as on the number of both sound and meaning errors produced. In all of the analyses reported below, transcortical sensory aphasics were grouped together with the single patient presenting the isolation of the speech area syndrome. This group, which consisted of patients with spared repetition and minimal comprehension, will hereafter be designated simply as transcortical sensory aphasics.

1. **Comparison of All Subject Groups**

In the initial analysis of variance, the performance of the seven subject groups was compared: A significant effect of Group was revealed \((F(6,37) = 3.40, p = .009)\). As Fig. 1 indicates, mixed anterior aphasics received the lowest scores, followed by conduction and Wernicke's aphasics, while transcortical motor and sensory, as well as anomic aphasics, received the highest scores.

A Group x Condition interaction which approached significance was also found \((F(6,37) = 2.21, p = .06)\). Broca's aphasics scored higher in the delayed condition (80% correct vs. 66% correct); anomic aphasics scored higher in the immediate condition (97 vs. 90%); and the remaining groups performed almost identically on both conditions.

A highly significant effect of Item type was also found \((F(10,370) = 17.16, p < .001)\). As Figure 2 indicates, monetary sums and nonsense syllables proved the most difficult to repeat whereas one-digit numbers and nouns proved the easiest. The order of difficulty of Item types was partly, but not entirely, a function of the mean number of syllables of the various items. Those items with the smallest mean number of syllables tended to fall on the upper end of the performance spectrum (e.g., one-digit numbers) while longer items tended to be on the lower end (e.g., money). However, length cannot be the only contributing factor: Nonsense words and CV monosyllables both proved more difficult to repeat than other longer items; and letters proved as difficult to repeat as two-digit...
numbers which were, on the average, twice as long. This profile of results suggests that meaningfulness also makes a contribution to the ease with which an item can be repeated. Short items with no meaning—such as phonemes and nonsense syllables—were more difficult to repeat than those which possessed real world referents.

Finally, a Condition × Item Type interaction was revealed ($F(10,370) = 3.52, p < .001$). The order of difficulty of items was the same in both conditions. However, CV monosyllables proved easier to repeat in the Immediate than in the Delayed condition (78 vs 69% correct) as did nonsense syllables (67% vs. 60%). Conversely, three kinds of items proved easier to repeat in the Delayed condition: three-digit numbers (67 vs. 77%); percentages (67 vs. 73%); and fractions (72 vs. 78%). For the remaining items, no differences were found between conditions.

Several other analyses of variance were performed, each of which confirmed the significant effect of Item Type, as well as the relative order of difficulty of the various items. In the analyses discussed below, only results that shed additional light on the guiding hypotheses will be reported.

2. Conduction vs. Transcortical Aphasics

Analyses of variance were performed on the scorcs of conduction vs. transcortical sensory aphasics, as well as on the scores of conduction vs. transcortical motor and sensory aphasics, grouped together. Because the
overall pattern of results was the same for both analyses, only the results of
the latter analysis will be reported here.

A significant effect of Group was found \( F(1,21) = 6.45, p = .02 \), with
transcortical aphasics scoring higher than conduction aphasics. A
significant Group \( \times \) Item Type interaction was also found \( F(10,210) = 2.21, p < .02 \). While the order of difficulty of the items was
almost identical for both groups, the scores of the transcortical patients
were high for all item types to be repeated, whereas the scores of the
conduction aphasics spanned a much wider range. Thus, the scores
received by the transcortical group reached as high as 99% (for one-digit
numbers) and dropped only as low as 80% (for percentages). The scores
received by the conduction aphasics, however, ranged from 92% (for
one-digit numbers) to as low as 38% (for money).

3. Patients Blocked by Site of Lesion

In order to determine the comparative effect of site of lesion versus
comprehension deficit, two further analyses of variance were performed.
In the first of these, patients were blocked by site of lesion: mixed anterior,
Broca's, and transcortical motor aphasics formed the anterior group;
transcortical sensory, Wernicke's, and anomic aphasics composed the
posterior group.

A significant effect of Group was revealed \( F(1,30) = 4.60, p = .04 \), with
patients with posterior lesions performing significantly better than
those with anterior damage. A modest Group \( \times \) Condition interaction was
also found \( F(1,1) = 3.28, p = .08 \): while the Delayed condition
facilitated the performance of those patients with anterior damage, the two
conditions proved of equal difficulty for those with posterior lesions.

Finally, a significant interaction of Condition \( \times \) Item Type was revealed
\( F(10,300) = 2.81, p = .003 \): while CV monosyllables and nonsense items
proved easier in the Immediate condition, the other items were either
unaffected by condition (letters, nouns, one-digit numbers, money, and
"grammatical" words) or proved easier to repeat in the Delayed condition
(two- and three-digit numbers, percentages and fractions).

4. Patients Blocked by Severity of Comprehension Deficit

Subjects were also blocked by severity of comprehension impairment.
The performance of those with relatively spared comprehension (Broca's,
conduction, anomic, and transcortical motor aphasics) was compared with
the performance of those whose comprehension was significantly impaired
(mixed anterior, Wernicke's, and transcortical sensory aphasics). The only
significant effect revealed by this analysis was that of Item Type
\( F(10,420) = 23.40, p < .001 \). The fact that there was an effect of Group
when patients were blocked by site of lesion, but not when blocked by
severity of comprehension deficit, confirms that the ability to repeat is relatively unaffected by the ability to comprehend.

5. Sound Errors

A series of four repeated-measures analyses of variance was performed on the number of sound errors produced. When the numbers of sound errors produced by all seven subject groups were compared, a significant effect of Group was found ($F(6, 37) = 5.07, p = .001$). Mixed anterior and Broca’s aphasics produced the highest number of sound errors, followed, in descending order, by conduction, Wernicke’s, transcortical motor, transcortical sensory, and anomic aphasics.

A second analysis of variance, comparing only the performance of conduction and transcortical aphasics, however, revealed no significant difference between these two patient groups. When subjects were blocked by site of lesion, a significant effect of Group was found ($F(1, 30) = 11.68, p = .001$): Patients suffering anterior damage produced significantly more sound errors than did those with posterior damage. Finally, when patients were blocked by severity of comprehension deficit, no significant differences were found in the number of sound errors produced.

6. Meaning Errors

The same four analyses of variance were performed on the number of meaning errors produced. When the numbers of meaning errors produced by all seven subject groups were compared, a modest effect of Group was found ($F(6, 37) = 2.217, p = .06$). Conduction aphasics produced the highest number of meaning errors, followed, in descending order, by Wernicke’s, mixed anterior, Broca’s, transcortical sensory, transcortical motor, and anomic aphasics. When the number of meaning errors produced by conduction aphasics was compared to the number produced by transcortical motor and sensory aphasics, significant effects of both Group ($F(1, 21) = 7.704, p = .01$) and Condition ($F(1, 21) = 9.32, p = .007$) were found. Conduction aphasics produced significantly more meaning errors than did the transcortical aphasics; and significantly more meaning errors were produced by both patient groups in the Immediate than in the Delayed condition.

No significant effects were found when patients were blocked by either site of lesion or severity of comprehension deficit.

DISCUSSION

The present results yield a complex, yet explicable, picture of repetition in aphasic patients. The overall performance of the various patient groups on the two conditions of repetition reflects their clinical symptomatology:
Transcortical aphasics perform the best, conduction aphasics and mixed anteriors the worst. The relative difficulty of the various item types, however, proves quite similar across patient groups: Both number of syllables and degree of meaningfulness contribute to the ease with which an item is repeated (cf. Tsvetkova, 1976). Finally, counter to the speculations cited earlier about different mechanisms of repetition, the Immediate and Delayed conditions of presentations yield parallel results. These various indexes suggest that repetition—at least for isolated elements—may be a single, quantifiable capacity, reflecting the same factors independently of the variety of aphasia (cf. Heilman, Scholes, & Watson, 1976).

Nonetheless, some instructive differences consistent with the characteristics of specific aphasias have emerged. Anterior aphasics (especially those with Broca's aphasia) perform relatively better on the Delayed condition: Possibly the 3-set interval allows them to prepare their articulatory gestures with greater precision. Fluent aphasics, in contrast, do not benefit from such a delay; if anything, the anomic aphasics, who may have difficulty retaining the "image" or motor pattern of a word (Goldstein, 1948), are hindered by the 3-set delay.

Consistent with this line of analysis, sound errors are more likely to be produced by Broca's and other anterior aphasics, for whom articulatory problems are often marked. In contrast, conduction aphasics prove particularly prone to making errors in which they select a different member of the same category as the stimulus (meaning errors). This finding underlines the observation that conduction aphasics readily process for meaning but experience difficulty in retaining or reproducing the string of phonemes associated with a particular lexical target (Tsvetkova, 1976; Warrington & Shallice, 1969).

The performance profile on the various item types also proves revealing. Nonsense words are easier to repeat on immediate repetition since little, if any, means exist for self-cuing during the interval of delay. In contrast, numbers prove easier to repeat on the Delayed condition: It is possible that, with a delay, aphasic patients become less likely to erroneously produce the next number in a series and also gain the opportunity to produce helpful visual and tactile "images" of the desired number (Geschwind, 1965). Overall, numbers proved to be relatively easy to repeat, possibly because their referents have wide representation in the nervous system and are thus "robust" in cases of cortical insult (Gardner, 1974).

It has recently been noted, in a variety of linguistic and cognitive tasks, that a patient's performance reflects his overall level of comprehension rather than the site of his lesion (Gardner & Zurif, 1976). In view of this finding, it is of considerable interest that a patient's repetition capacity appears to be a function of site of lesion, rather than overall level of comprehension. These apparently contradictory findings can be reconciled if one postulates that production and comprehension capacities are
organized differently in the nervous system. It is only on certain kinds of
tasks of linguistic production that performance reflects the site of lesion:
Otherwise, the overall comprehension level is likely to prove critical.

Turning, finally, to a question which motivated the present investigation,
the results fail to demonstrate major qualitative differences between the
repetition performances of conduction and transcortical aphasics. If
anything, the overall response profiles of the two groups proved
surprisingly similar. Nonetheless, hints of a qualitative difference can be
found in the performance by the two groups on the various item types. That
is, the relative flatness across item types on the repetition scores of the
transcortical aphasics documents that the nature of the isolated stimulus
item does not greatly affect the likelihood that it will be accurately
repeated. In contrast, the steep slope across item types yielded by the
scores of the conduction aphasics indicates that the nature of a stimulus
item (its meaningfulness, its imageability) matters significantly for this
group of patients. Overall, the results suggest that repetition is a far more
active and constructive process in this latter group of aphasics.

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