Performance of Aphasic Listeners on an Expanded Revised Token Test Subtest Presented Verbally and Nonverbally

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Although a complete understanding of aphasia remains elusive, the behavioral characteristics of the disorder are well documented. Notable among them is the high degree of variability shown by aphasic persons. McNeil (1982) noted that variability can occur over various temporal measures such as second to second or morning to afternoon. He also suggested that aphasic behavior can be variable across repeated trials of the same unit or across different items which are equally difficult. McNeil contended that analysis of the variability in aphasic persons' performance could provide information on the loss-versus-interference issue in aphasia. McNeil (1983) suggested that internal state factors (ISF) (as yet unidentified biological fluctuations within the individual) cause intact knowledge to be inaccessible to the individual. He proposed mathematical formulae for determining the amount of deficit attributable to performance factors as opposed to loss of competence. These mathematical procedures allow us to determine the percentage of deficit that represents the difference between what the subject has shown he or she can do compared to what he or she typically does. He stressed the importance of measuring variability of performance across several items of equal difficulty. The Revised Token Test (RTT--McNeil and Prescott, 1978) allows researchers to examine variability because it is a reliable instrument, sensitive to small changes in performance and has subtests consisting of several homogeneous items.

Brookshire (1974) described five types of auditory deficit patterns. They were: slow rise time, noise build-up, retention deficit, information capacity deficit, and intermittent auditory imperception. Since then other patterns have been proposed including tuning-in, tuning-out, and flat (McNeil and Hageman, 1979). A number of investigations have examined these patterns (Hageman, 1980; Hageman and Lewis, 1983; Hageman, McNeil, Rucci-Zimmer and Cariski, 1982; McNeil and Hageman, 1979). The only pattern to be observed consistently across items within subtests has been the intermittent pattern.

Another important aspect of processing impairment in aphasic persons is increased processing time. The RTT attempts to capture this aspect of performance by scoring delays. In addition, the RRT captures another temporal behavior indicative of poor processing termed immediacy which means responding too soon, before the message is complete. Since the RTT requires stimulus detection, stimulus recognition and execution of an appropriate motor response, the RTT could be considered as a choice reaction time task. Celebi (1978) observed that, despite numerous attempts to identify the source of reaction time variability, "the statistical distribution of RT values seems to have received little attention" (p. 355).

One purpose of this investigation was to examine the auditory comprehension and visual imitative abilities of aphasic listeners with respect to patterns of performance and accuracy of performance. A second purpose was to examine the response time variability of aphasic listeners across equally difficult items. A third purpose was to determine the amount of deficit that could be attributed to internal state factors.

METHOD

Seven aphasic individuals comprised the sample group (Table 1). The subjects were selected on the basis of their medical diagnosis and their performance on a standard administration of the RTT. The subjects were heterogeneous with respect to age, sex, time post-onset, etiology, site of lesion and severity. Each subject passed the RTT pretest and no subject required a repeat or cue on more than two of the items in RTT subtest IV.

Table 1. Descriptive data for subjects.

	Subjects						
	A	B	C	D	E	F	G
Sex	M	F	M	M	F	M	M
Age	69	55	58	55	83	54	74
Type of Behavior*	ex/re	ex	ex/re	ex/re	ex	ex	ex/re
Months Post-Onset	24	24	36	12	24	60	2

*ex = expressive; re = receptive

Each subtest of the RTT contains 10 items of equal difficulty. Each item contains eight elements which are individually scored. A mean item score is obtained from the eight elements and the subtest mean score is a mean of the item scores. For this expriment, the 10 command items of RTT subtest IV were used to generate the stimulus items. A trained examiner produced the 10 commands which were recorded in a sound treated room using a Teac tape recorder. Each of the 10 commands was copied 10 times, in random order, onto another tape which then contained 100 stimulus items thus becoming the Expanded Auditory Test (EAT). A twelve-second interstimulus interval was maintained. Since response time measures were to be obtained, it was necessary to determine the length of each command. The length of each command was determined by spectrographic analysis using the Kay Elemetric Sona-Graph, model 6061A.

The response time data were collected using a specially constructed wooden frame with a plywood bottom. A plexiglass cover was mounted within the frame on a pivot at midline with two microswitches positioned under the plexiglass to regulate time onset and offset. During the auditory task, the headphone output of the tape recorder was routed to a Hunter voice-activated relay (model 320S) which started the timing instrument (Lafayette clock/counter). The timer continued until the subject touched the first token (the tokens were placed on the plexiglass) which activated the microswitch, stopping the timer. During the interstimulus interval the examiner scored the subject's response using the standard RTT scoring procedure. An assistant recorded the raw response time data and reset the timer.

The same 100 items were presented to each subject as a nonverbal (non-auditory) task, the Expanded Visual Test. The subjects were instructed to watch the examiner and then touch the same tokens. The examiner listened to the test tape and touched the tokens as they were presented, which maintained a presentation rate equal to the auditory task. When the examiner touched the second token, the timer was activated. The subject stopped the timer by touching the first token. The subject's performance was scored in the standard manner by the examiner and an assistant recorded the response time and reset the timer.

Descriptive and quantitative analyses of the patterns generated by the subject's RTT item scores were completed following McNeil and Hageman's (1979) guidelines. For response time data, successive items having response times greater than plus/minus one standard error of measurement were considered meaningfully different. Computation of ISF values were based on McNeil's (1982) mean method. A one-way analysis of variance for repeated measures (Steinmetz, Romano, and Patterson, 1981) was computed when appropriate and the Tukey test for multiple comparisons (Hopkins and Glass, 1978) was used to test for specific differences.

RESULTS

First, a quantitative analysis of the subjects' performance was completed. This analysis tested the quantitative performance of the subjects on the auditory task compared with the visual task. In addition, the quantitative performance of the subjects at the beginning of the auditory tasks was compared with their quantitative performance at the end. Thus, mean scores were examined for significant differences across the standard RTT subtest IV, the expanded auditory test (EAT), the first 50 items of the EAT, the last 50 items of the EAT, the first 10 items of the EAT, the last ten items of the EAT and the expanded visual test (EVT). The mean scores are shown in Table 2.

The analysis of variance procedure (Table 3) and the Tukey Test for multiple comparisons revealed that the mean scores in one comparison differed significantly. The expanded auditory test mean scores were significantly ($p < .05$) lower than the scores on the EVT. The RTT mean scores for the standard, the EAT, the first 10 items from the EAT, and the last 10 items of the EAT were not significantly different. The visual presentation was significantly easier than the listening task for these aphasic subjects to complete ($p < .05$). There was no evidence to suggest that these aphasic listeners performed quantitatively differently from the beginning to the end of the EAT.

Second, the patterns of across item-within subtest performance that developed were of interest. With respect to the RTT scores, the only across item-within subtest pattern which occurred for the auditory tasks (both the standard RTT and the EAT version) was the intermittent pattern. This pattern was confirmed by the quantitative analysis reported above, in which no significant differences in performance were observed from the beginning to the end of the EAT. However, a pattern analysis of the RTT scores for the EVT showed that 43 percent showed a flat pattern and 29 percent demonstrated a tuning-in pattern. When the response time data are examined, the only pattern that emerges is intermittent. This was true for the EAT and EVT for every subject.

Table 2. Mean values by subject for each variable within the auditory and visual-manual presentations.

	Subjects							
	A	B	C	D	E	F	G	Mean
Auditory								
Entire standard RTT	13.21	14.01	14.39	12.46	12.42	13.21	11.58	13.04
Standard subtest IV	12.90	14.30	14.50	12.48	12.50	12.73	11.51	12.99
Total expanded test	14.57	14.80	14.44	11.83	11.95	13.81	11.66	13.29
First 50 items	14.47	14.73	14.54	11.87	11.90	13.92	11.77	13.31
Last 50 items	14.66	14.87	14.34	11.80	12.01	13.70	11.54	13.27
First 10 items	14.33	14.63	14.60	12.16	12.51	13.45	11.89	13.37
Last 10 items	14.90	15.00	14.28	11.62	11.25	13.63	11.73	13.20
Visual-manual								
Total expanded test	14.69	15.00	14.99	14.97	15.00	14.98	14.85	14.93

Table 3. One-way analysis of variance with fixed effects: Standard and modified versions of RTT Subtest IV.

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F-ratio
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Between	16.996	4	4.249	2.944*
Within	43.303	30	1.443	

*significant $p < .05$.

Table 4 shows the internal state factor (ISF) values obtained for all measures. In all cases, ISF was greater than 99 percent and was actually 100 percent in 18 of 21 possible occurrences.

An analysis of variance (Table 5) showed that the ISF values were not significantly different across tests. The ISF values were the same for both tasks even though the EAT was significantly more difficult than the EVT.

Table 4. ISF values (percents) for Subtest IV and the expanded RTT in its auditory and visual-manual presentations.

	Subjects						
ISF Values	A	B	C	D	E	F	G
Subtest IV	100%	100%	100%	99.7%	100%	100%	99.7%
Expanded auditory	100%	100%	100%	100%	100%	100%	99.8%
Expanded visul-manual	100%	100%	100%	100%	100%	100%	100%

Table 5. One-way analysis of variance with fixed effects: ISF comparisons.

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F-ratio
Between	.026	2	.013	1.534*
Within	.153	18	.0085	

*Not significant $p > .05$.

DISCUSSION

McNeil and Hageman (1979) had hypothesized that four across item-within subtest patterns could occur. The results of this study suggest that when the task is reasonably difficult the only across item-within subtest pattern is intermittent. The presence of what appear to be other patterns of auditory processing may actually be artifacts of the number of items presented or the length of the time period sampled. This investigation is particularly relevant to the issue of fatigue or tuning-out as a pattern of behavior. These subjects performed a task that held difficulty constant across 100 items. There was no significant difference in performance from the beginning to the end of the test. Thus, it would appear that tuning-out does not occur, at least not over a reasonable number of items (100) or over about 30 minutes. The tuning-in pattern did not occur either. Subjects did not profit from repeated trials of RTT commands, suggesting that one cannot learn to take the RTT or that aphasic listeners cannot adjust their effort allocation to perform better.

The occurrence of the tuning-in and flat patterns on the visual task was due to the low level of difficulty combined with a scoring system that is not sensitive to extremely small variations in performance. The pattern presented by this measure could best be described as intermittent.

The subjects performed significantly better on the visual task compared with the auditory task. Short-term memory is one cognitive process that is involved in the execution of these tasks. Crowder (1972) suggested that acoustic storage (echo) lasts two to four seconds while the visual storage (iconic) lasts one fourth of a second because "in vision ... the human being can often arrange for the persistence of the stimulus itself without need of a persistent stimulus trace." (p. 256). The visual task in this study was such that the subjects could continue to view the tokens. Consequently, encoding in visual short-term memory may not have been required and the command items may have been processed as two rather than eight units.

The ISF values (over 99%) support the contention that errors were not made because of inability to perform the tasks but because of inability to do so all of the time. The high ISF values lend support to McNeil's (1982) premise that aphasia is a phenomenon of interference, not loss. Had a loss of competence been operating, one would have expected lower ISF values.

McNeil (1984) suggested that an internally generated oscillator may be contributing to fluctuations in performance in aphasia. The length of the EAT allowed us to examine this issue at a behavioral level. The item mean scores for each subject were converted into z scores. The location in time of z scores more negative than minus one were noted. When this was done, we observed that over 50% of the scores that were more negative than minus one were adjacent in time or occurred within an item. While this clustering of deviant scores is not sufficient evidence to refute or support the cyclical nature of performance in aphasia, it certainly provides a point of reference for future investigation.

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