The Effects of Intrastimulus Pause on the Quality of Auditory Comprehension in Aphasia

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Stimulus presentation characteristics are considered to be important in aphasia therapy. According to Yorkston, Marshall and Butler (1977), factors which affect the proficiency with which aphasic listeners decode auditory input fall into two general categories. One category includes stimulus content considerations such as syntactic complexity and length of message. The second category is the manner of stimulus presentation, and includes the temporal aspects of stimulus presentation, such as rate of stimulus presentation, imposition of within-phrase pauses, and imposed delay of response. It is this second category of manipulating the temporal aspects of the stimulus that was of interest in this investigation.

Researchers such as Albert and Bear (1974), Gardner, Albert and Weintraub (1975) and Wiedner and Lasky (1976) have shown that presentation rate is important for comprehension and that slower rates of speaking enhance auditory comprehension in aphasic listeners. Yorkston (et. al., 1977) demonstrated that additional processing time imposed between the stimulus presentation and the response facilitated auditory comprehension when memory load was reduced by including a visual input with the auditory input.

Intrastimulus pause has also been suggested as a facilitator of auditory comprehension. Suci (1969) and Fillenbaum (1970), among others, have suggested that recall of auditory input is better when pauses are placed at major syntactic boundaries compared to when they are placed within syntactic groupings. Salvatore (1974, 1978) reported that aphasic listeners could learn to use a pause to facilitate auditory comprehension and that the greatest increase in the number of correct responses occurred with a 2-second pause. Liles and Brookshire (1975) investigated the use of intrastimulus pause with auditory stimuli and found that a five-second pause facilitated auditory comprehension when the pause separated the message into units of two descriptors (information units) on either side of the pause. Liles and Brookshire concluded that the aphasic listeners used increased pause time pause time within a message for linguistic processing operations because the listeners could understand the message components when each component was presented in isolation. Thus, it appears that aphasic listeners can improve their performance when additional time is allowed to process spoken messages.

Most investigators of auditory comprehension have measured the amount of information correctly comprehended. Another way to study auditory comprehension is to examine the quality or pattern of performance shown by aphasic listeners. McNeil and Hageman (1979) demonstrated that the Revised Token Test (RTT: McNeil and Prescott, 1978) was capable of eliciting patterns of auditory comprehension. They noted that patterns of processing should be classified according to test construction as well as by the task performed. They reported that the RTT elicited both across-subtest patterns (tuning in, tuning out, flat, intermittent, plus length, munus length and specific linguistic) and across-item-within-subtest patterns (tuning in, tuning out, intermittent and flat).

At the time these patterns were presented (Clinical Aphasiology Conference, 1979), several participants raised questions concerning the nature of these patterns and, specifically, wondered whether these patterns would occur with the same frequency under different listening conditions and whether they were trainable. This investigation was an attempt to examine the consistency of auditory comprehension patterns when an intrastimulus pause was placed within the RTT commands. Since pauses inserted within a stimulus appear to improve comprehension, a pause inserted within the commands of the RTT may improve the aphasic listener's performance and, therefore, affect the frequency with which patterns of auditory comprehension disabilities occur. If differences in stimulus length and different grammatical construction influence the interaction of the pause with performance, as suggested by Liles and Brookshire (1975), the patterns obtained from the RTT data should demonstrate that interaction because of the administrative consistency of the RTT across different sentence lengths and different grammatical construction.

Three specific questions were asked. 1) Is the percentage of occurrence of across-subtest patterns and percent of subjects displaying each pattern significantly different for the standard RTT compared with the amended RTT (with pause inserted)? 2) Is the percentage of occurrence of across-item-within-subtest patterns and percent of subjects displaying each pattern significantly different for the standard RTT compared with an amended RTT (with pause inserted)' 3) Is the frequency of item score changes within subtests significantly differen for the standard RTT compared with the amended RTT?

METHOD

Subjects. Subjects were six males and four females with left hemisphere brain damage and aphasia. They were heterogeneous with respect to age, severity, type of aphasia and etiology. All subjects were at least 4 months post onset and were neurologically stable. Table 1 provides specific data concerning age, time post onset and severity of aphasia as measured by the RTT. The subjects were determined to have adequate perceptual ability to complete the experimental task.

Table 1. Auditory comprehension level, age, and months post-onset of aphasi for 10 aphasic subjects.

Subject	Age	RTT Percentile	Months Post-Onset
1	57	52	6
2	59	7	18
3	28	9	63
4	56	27	128
5	79	11	38
6	71	29	4
7	68	15	52
8	65	2	30
9	53	91	18
10	63	2	144

Stimuli. Stimuli consisted of two presentations of the Revised Token Test. For one presentation, the RTT was presented in the standard manner by a trained and reliable tester. The second presentation, the amended RTT, was presented by the same examiner with the following changes in stimulus presentation. A two-second pause was inserted at the major within-sentence breaks as suggested by Fillenbaum (1970). Table 2 provides examples of pause placement. In order to maintain a consistent two-second pause across items, the amended RTT commands were recorded using a Wollensak 1520 AV audio tape recorder at 7 ips. The length of each pause was measured with a Tektronics 564 storage oscilloscope to ensure that all pauses were two seconds plus or minus 200 milliseconds. One-half the subjects received the standard RTT first and one-half received the amended RTT first. Only one test was administered each day with no less than one and no more than seven days between sessions.

Table 2. Examples of pause placement for the amended Revised Token Test.

Subtest	Command
I	Touch (pause) the black circle.
III	Touch the green square (pause) and the black square.
V	Put the black square (pause) in front of the big white circle.
IX	Touch the blue circle (pause) instead of the green circle.

The RTT yields data that can be analyzed quantitatively and qualitatively. Quantitative analysis included comparing the scores earned by the subjects on Subtest I (standard RTT) with their scores on Subtest I (amended version) using a t-test for dependent observations (Nie, N. H., Hull, C. H., Jenkins, J. G., Steinbrenner, K., and Bent, D. H., 1975) to test for differences. All other subtest pairs, II through X, were likewise examined for significant differences.

Qualitative analysis was accomplished by determining the presence of patterns in the way described by McNeil and Hageman (1979). A percentage of occurrence of each pattern for each test administration was calculated for both across-item-within-subtest patterns and across-subtest patterns. The percentage of subjects demonstrating each across-item-within-subtest pattern and each across-subtest pattern at least once was also calculated. A Chi-square Goodness of Fit test (Hopkins and Glass, 1978) was used to test for significant differences in the proportion of pattern occurrences across test conditions for both within-subtest and across subtest patterns.

Another way to examine the pattern of performance with a subtest is to calculate the frequency of item score changes of .20 or more on successive items. Proportions based on the total possible score changes (9) within a subtest can be calculated for each subject on each subtest. The proportions obtained for each subtest were compared across administrations for each subject using the Chi-square procedure. In addition, the total score changes between successive items were calculated across subtests for each administrative condition and were

Table 3. Summary of t-tests for each subtest pair across administration conditions and Pearson product-moment correlation coefficients for each subtest pair.

Subtest	Mean	RTT Percentile	t-value	Correlation
I Standard	12.57	14th	.77	.27
I Amended	12.78	18th		
II Standard	12.06	22nd	.51	.50
II Amended	12.16	24th		
III Standard	11.24	26th	1.19	.29
III Amended	10.95	18th		
IV Standard	10.95	19th	1.95	.49
IV Amended	10.53	13th		
V Standard	10.69	32nd	1.33	.62
V Amended	10.45	30th		
VI Standard	10.39	33rd	.23	.54
VI Amended	10.34	33rd		
VII Standard	10.13	22nd	.72	.44
VII Amended	10.46	27th		
VIII Standard	9.92	32nd	1.12	.58
VIII Amended	10.12	35th		
IX Standard	9.56	3rd	2.63*	.48
IX Amended	10.39	10th		
X Standard	9.86	5th	1.10	.30
X Amended	10.20	7th		

*significant at p .01

compared using a t-test for dependent observations (Hopkins and Glass, 1978). Finally, to examine the consistency of patterns produced by each individual, the number of pattern changes from the standard RTT to the amended RTT were counted for each individual, and a percentage of pattern consistency was obtained for across item-within-subtest patterns and across-subtest patterns.

RESULTS

The mean score for each subtest, percentile equivalent t-value, and Pearson product-moment correlations are presented in Table 3. Only the difference in quantitative performance on subtest IX between test administrations was significant. However, since ten t-tests were performed, the probability that this difference may have occurred by chance is high. That the two-second pause did not change the quantitative performance of the aphasic listeners on the RTT is clear.

Table 4. Prevalence of across item-within subtest patterns for 10 left hemisphere brain-damaged aphasic listeners in percent.

	Intermittent	Flat	Tuning-in	Tuning-out
RTT (Standard)	95	4	0	1
RTT (Amended)	95	5	0	0

Table 4 and 5 present the percentage of across-item-within-subtest patterns and the percent of subjects displaying each pattern for each test condition. As can be seen, the percentages are nearly identical for both prevalence of pattern type and percent of subjects. The Chi-square test revealed no significant difference for the percent of pattern occurrence (.05 x^2_3 = 7.81, x^2 = .11) or for percent of subjects (.05 x^2_3 = 7.81, x^2 = 1.00). Intermittent performance was the only pattern to occur in all subjects, and it was the most prevalent pattern. The pattern of auditory comprehension for these ten aphasic listeners does not appear to change within subtests across test administrations with the RTT.

Tables 5. Percent of subjects showing each across-item-within subtest pattern for 10 left hemisphere brain-damaged aphasic listeners.

	Intermittent	Flat	Tuning-in	Tuning-out
RTT (Standard)	100	20	0	0
RTT (Amended)	100	10	0	0

Tables 6 and 7 show the percent of each across subtest pattern and the percent of subjects displaying each across subtest pattern for each test adminstration. Again, the percentages are in close agreement. The Chi-square test revealed no significant difference ($.05\ x^2_6 = 12.6$, $x^2 = .73$) for the percent of pattern occurrence or for the percent of subjects ($.05\ x^2_6 = 12.6$, $x^2 = 1.78$). Thus, the style of this group of ten aphasic listeners' auditory comprehension does not appear to change across test administrations. Pause time does not appear to interact with the mechanism which underlies the production of these patterns. Pause time did not differentially affect aphasic listener's performance on the linguistic constructions contained in the RTT.

Table 6. Prevalence of across subtest patterns for 10 aphasic listeners in percent.

	Flat	Tuning-in	Tuning-out	Minus Length	Plus Length	Specific Linguistic	Inter-mittent
RTT (Standard)	0	0	0	24	15	56	5
RTT (Amended)	0	0	0	31	7	59	3

The t-test for dependent observations calculated to examine the frequency of item score changes of .20 or more for each test administration revealed no significant difference ($.95t_g = 1.83$, $t = 1.52$, $rxy = .88$). Thus, for this group of aphasic listeners, intrastimulus pauses did not affect the frequency of item score changes. In order to examine each individual's performance, the Chi-square procedure was completed for each subject, comparing the proportion of item score changes for each subtest for each administration. Table 8 summarizes the Chi-square data. Comparisons were not significantly different except for Subject 9. Subject 9 performed differently than the other subjects by demonstrating more flat patterns in pause condition. This subject apparently was able to use the immediacy type of response when a pause was inserted in the command to facilitate correct recall of lexical items.

Table 7. Percent of subjects showing each across subtest pattern for 10 aphasic listeners (in percent).

	Flat	Tuning-in	Tuning-out	Minus Length	Plus Length	Specific Linguistic	Inter-mittent
RTT (Standard)	0	0	0	90	60	100	40
RTT (Amended)	0	0	0	100	40	100	20

Hageman, McNeil, Rucci-Zimmer and Cariski (1982) reported that across-item-within subtest patterns and across-subtest patterns are elicited reliably for aphasic listeners as a group by the RTT. However, within individual listeners, the patterns varied considerably upon retest for across-subtest patterns but not for within-subtest patterns. The data from this investigation show a similar finding. The across-item-within subtest patterns were consistent, with five subjects showing 100 percent agreement and the remaining five with 90 percent agreement. Intermittent performance within subtests remained intermittent performance regardless of the listening condition. However, for across-subtest patterns, an average of only 47 percent of the patterns remained the same within an individual despite nearly perfect agreement for the group. The extra processing time did not appear to systematically interact with sentence length or linguistic construction. In fact, 53 percent of the time the pattern appears to change randomly.

Table 8. Chi-square values for proportion of item score changes within subtests across administration by subject.

Subject	1	2	3	4	5	6	7	8	9	10
	17.24	18.1	5.81	2.89	5.75	14.04	3.88	12.42	46.52*	13.49

*significant at $p < .05$

CONCLUSIONS

It was somewhat surprising that the introduction of the two-second intrastimulus pause did not significantly improve the scores of these aphasic listeners on Subtest 1. This subtest contained two or less units of information on either side of the pause and Liles and Brookshire (1975) demonstrated that aphasic listeners improved their performance with a five-second pause separating the command into two parts each having two or less units of information. It may be that a two-second pause is not long enough to result in improvement at first exposure. The remaining subtests, however, have three or more units of information on either side of the pause which was found to negate the positive influence of the pause. The data from this investigation support Liles and Brookshire's contention that an intrastimulus pause does not facilitate performance when there are three units of information on each side of the pause.

It appears that the mechanism underlying the production of patterns of auditory comprehension is extremely stable and that additional processing time does not change patterns of auditory comprehension. If a person learned to make use of a pause, we might have expected a tuning-in pattern to develop, perhaps especially in the later subtests. However, this did not occur.

Hageman (et. al., 1982) reported that the quality of auditory comprehension does not vary with test-retest using the RTT for a group of aphasic listeners, but that for individual subjects the pattern of performance can change radically from one administration to another. Precisely the same phenomenon occurred in this investigation. Group data remained constant while individuals displayed changing patterns. Thus, it would appear that there is a variable more potent in the formation of auditory comprehension patterns than the interaction of processing time with linguistic parameters (at least those measured with the RTT) or sentence length. Across all of these conditions subject intermittency is the only pattern which is found to occur consistently within subtests. It may be that the patterns that develop across subtests are actually a manifestation of intermittent behavior occurring during the course of the test administration and therefore such patterns as minus length are really artifacts of intermittent performance. The sources of this intermittent performance could be related to internal factors such as fluctuations in effort allocation or a naturally occurring oscillation of performance that only becomes apparent when tasks are difficult enough for numerous errors to be made, such as a listening task for aphasic subjects or a competing listening task for normal listeners (Hageman, 1980). Oatley and Goodwin (1971) stated that:

> Rhythmic occurrence of events, though common place in biology, have only recently been considered to play an important role in living systems...Supposedly static conditions have been studied, helped by mixture of standardized stimulus arrangements and statistical tests. However, if there are important periodic processes within an experimental subject, a stimulus at one time will not have the same effect as the same stimulus at another time, and carrying out statistical tests merely assumes that any variations are noise. An alternative is that periodic variations are of the essence.

Consequently, another factor which could influence the proficiency with which aphasic listeners decode auditory input could be the moment to moment change in the internal readiness of the individual to process incoming information.

If these remarks have any validity, then the answer to the question "Are these patterns trainable?" asked at the 1979 Clinical Aphasiology Conference would be "no," because only one pattern appears to exist; that is, the intermittent one. It remains to be seen, however, whether the source or sources of intermittent behavior can be manipulated to improve performance of aphasic listeners.

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