Effects Of Ear Presentation And Delayed Response On The Processing Of Token Test Commands By Aphasic Adults

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Impairment in processing auditory stimuli traditionally has been recognized as a significant component of the symptomatology of aphasic individuals, and the relevance of auditory factors forms the core for some current approaches to aphasia treatment.

A growing body of literature suggests that aphasic subjects may present identifiable patterns of auditory dysfunction (Brookshire, 1972; LaPointe, et al., 1974) and that temporal and prosodic factors can be manipulated to affect comprehension (Liles and Brookshire, 1975 Salvatore, 1975; Weidner and Laskey, 1976).

The genesis for some of the interest in our search for clues to a clinically relevant model of auditory comprehension in aphasia is provided by the considerable work in dichotic listening. Stimulated by the foundation provided by Kimura (1967) and her associates, a host of researchers began exploring the nature of responses to dichotically presented stimuli in a variety of subjects with communication pathologies.

The apparent fascination between manipulations of auditory stimuli and expansion of our understanding of hemispheric asymmetry has assured the aphasic subject a prominent place in dichotic studies. Kimura (1967) got it started by pointing out that dichotically presented competing speech is perceived less well in the ear contralateral to the damaged hemisphere.

Others have been quick to continue this line of research. Studies by Petit (1969), Sparks, et al. (1970), Shanks and Ryan (1974) and Johnson, Sommers and Weidner (1977) for the most part have shown a left ear preference with aphasic subjects. This is just the opposite of the right ear preference found in an overwhelming majority of normal adult subjects.

Petit (1969) suggested that the left ear advantage demonstrated by aphasic subjects results from a "shift in cerebral dominance for speech". Sparks et al (1970) reported that half of their aphasic subjects evidenced left-ear preference and half right-ear preference, as did Shanks and Ryan (1974) who speculated that different lesion sites within the left hemisphere might account for their findings.

Most of the competing message dichotic studies of aphasic subjects emphasize in their discussion that time post-onset may be an important variable and may, in fact, reflect changes in function of the two hemispheres during recovery.

A most recent study by Johnson et al. (1977) adds initial severity of aphasia as a potentially significant influence on ear preferences. These researchers found a strong left ear preference in 20 aphasic subjects and revealed further that initial severity of aphasia was highly correlated with the magnitude of ear preference; but that time post-onset was not.

All of this research on dichotically presented competing messages and the subsequent relationship of ear preference to the impaired left hemisphere has triggered some speculation about how aphasics respond to monaurally presented non-competing messages.

Our interest in this was initially whetted by a report at the 1973 Clinical Aphasiology Conference by Peterson and Wilson. They reported some implication-laden preliminary results which suggested that some aphasic subjects with severe auditory deficits demonstrated better performance in the left ear when a delayed matching task was presented to each ear separately.

Further, when their aphasic subjects were asked to perform the same matching task with non-competing binaural presentation, performance was poorer than the messages presented to the left ear only. Subsequently, Peterson (1973) produced a dissertation which elaborated on the initial design. Eight aphasic subjects were tested on a "symbolic cross-modality delayed matching task". Essentially, subjects were asked to listen to a single stimulus word and, after a delay, were shown a panel of four drawings. They were asked to indicate the stimulus item they had heard by pressing the appropriate portion of a response panel.

Peterson found "a right ear decrement as compared to left ear performance.." and again demonstrated left ear monaural superiority over binaural stimulation. Subjects with posterior temporo-parietal damage were more likely to show this left ear superiority than were subjects with "more anterior damage".

The reason for this left ear superiority is assumed to be based on the functional pre-potency of the contralateral auditory pathways, where each ear is best represented in the auditory centers of the contralateral cortex. It is speculated that the existence of the aphasia causing lesion in the left hemisphere compromises the integrity of the message presented to the right ear and accounts for the finding of more accurate performance when the left ear alone is stimulated.

Further, the effect of "binaural suppression", or poorer scores by binaural presentation as compared to monaural left ear stimulation, is postulated as resulting from interference in the auditory processing of left ear input because of inclusion of the poorer right ear.

The implications of this research are obvious. In daily life, the aphasic patient received his auditory input binaurally. Perhaps limiting input to the left ear alone would significantly alter his ability to deal with auditory material. Our original image was one in which all of our aphasic patients would be fitted with instrumentation which channeled all messages to the left ear. At the very least, and much more practically, we could present our instructions and clinical tasks to the left ear only and expect more efficient performance during therapy.

However, our first question about these preliminary findings regarded their replicability with more complex linguistic units. Therefore, the purpose of the present study was to further explore the relationships among ear presentation and a delay - no delay condition on the ability of aphasic subjects to process Token Test Commands.

Procedures

Eight aphasic subjects were presented 15 Token Test Commands (2 commands from each of the first four subtests, and 7 commands from subtest V). Our subjects ranged in age from 47 to 82 years with a mean of 58.6 years. The range of months post-onset was from 2 to 74 months with a mean of 17.6 months, and the overall severity of aphasia ranged from the 36th to the 68th percentile on the PICA. All subjects were aphasic as a result of thromboembolic CVA's, except for one, who suffered closed head trauma. Pure tone thresholds were obtained on all subjects and no subject was included who had a hearing loss atypical for his age group or who presented significantly unequal thresholds between ears. We were unable to record unequivocal localization of the lesions in our sample, but four of our subjects present fluent aphasia and other clinical neurological signs which probably indicated posterior lesions.

Several subjects were run in a pilot study to aid us in checking the equipment. Slide one illustrates two subjects from our pilot study. (Slide of pilots)

The Token Test Commands were presented in a sound treated room from a tape recording, through a system which included a Grason-Stadler attenuator and calibrated TDH-39 earphones, at 40 dB sensation level. One experimenter operated the tape recorder and attenuator and a second experimenter interacted with the patient; covered the Tokens for eight seconds under the delay conditions; and scored responses. The commands were presented under the following conditions:

1. No delay, binaural
2. No delay, left ear only
3. No delay, right ear only
4. Delay, binaural
5. Delay, left ear only
6. Delay, right ear only

The next slide is an illustration of the left ear only.

The next slide depicts the right ear only.

And... you're probably way ahead of me now...the next slide, does indeed, illustrate both ears.

Order of presentation was counterbalanced for all conditions and the pool of 720 responses (15 commands by 6 conditions by 8 subjects) was analyzed.

For clarification, Table 1 is a summary of the procedures in this study.

Table 1. Ear Effect: Summary of Procedures

8 Aphasic Subjects
15 Token Test Commands (I-V)
3 Presentation Conditions (Left Ear, Right Ear, Binaural)
2 Response Conditions (Delay, No Delay)
Order Of All Conditions Counterbalanced
Corpus Of Data: 720 Responses
(15 Commands x 6 Conditions x 8 Subjects)

As you recall, we had 8 aphasic subjects; 15 Token Test Commands; 3 presentation conditions (that is, left ear, right ear, and binaural); 2 response conditions (delay and no delay); order of all conditions was counterbalanced; and we analyzed 720 responses.

Results

Table 2 is a display of the correct response scores for all subjects with the delay and no delay conditions pooled. As you see, subjects scored 118 (or 79%) correct responses (out of a possible 150) for the left ear; 124 (or 83%) for the right ear; and 120 (80%) for binaural presentation.

Table 2. Scores For All Subjects: Delay, No Delay Pooled (150 Possible)

Left Ear	Right Ear	Binaural
118 (79%)	124 (83%)	120 (80%)

Differences Not Statistically Significant

A Friedman two-way analysis confirmed the obvious and yielded a non-significant result. This implies that there is no evidence of either mode-condition interaction or main effects.

Table 3. Scores For All Subjects: Delay Condition (75 Possible)

Left Ear	Right Ear	Binaural
60 (80%)	59 (79%)	57 (76%)

Differences Not Statistically Significant

Table 3 displays the correct responses of all subjects for the no delay condition only. As you see, out of 75 possible correct responses, subjects scored 58 (78%) for the left ear; 65 (87%) for the right ear; and 63 (84%) for both ears. Again, these results are not statistically significant.

Table 4 displays the data for all subjects under the 8 second delay condition. There are 75 possible correct responses and subjects scored 60 (80%) for the left ear; 59 (79%) for the right; and 57 (76%) for binaural presentation. Again, these differences failed miserably, to reach statistical significance.

You may have noted that the group data indicated that fewer correct responses were produced under the delay condition (176 versus 186); but these results were not significant.

Table 4. Scores For All Subjects: No Delay Condition (75 Possible)

Left Ear	Right Ear	Binaural
58 (78%)	65 (87%)	63 (84%)

Differences Not Statistically Significant

Analysis of individual subject performance, however, revealed three subjects who performed considerably poorer under the delay condition.

That is illustrated on Table 5 by the comparative delay-no delay scores for subjects 4, 5 and 6. These subjects did quite a bit better when they were not asked to retain the command for 8 seconds before responding. One subject, number 7, presented the reverse, and performed more accurately when he was allowed 8 seconds to process and, we might speculate, rehearse the message before responding. Perhaps this indicates an auditory processing lag impairment. Analysis of these individual scores supports the view that some aphasic subjects demonstrate distinctive patterns of auditory comprehension impairment, and again points out the need for probing the specific nature of each individual patient's pattern of auditory impairment in order to most efficiently guide an intervention strategy. We found, however, no distinctive pattern of performance in the subjects we classified as "fluent", when compared to those classified as "non-fluent".

Table 5. Individual Subject Scores

Subject #	No Delay	Delay	Difference
1	17	18	+1
2	5	8	+3
3	15	15	0
4	29 Retention ?	20	-9
5	41 Retention ?	35	-6
6	32 Retention ?	23	-9
7	24 Processing Lag ?	30	+6
8	23	24	+1

The results of this study failed to confirm previous suggestions that some aphasic subjects perform significantly more accurately by input of non-competing messages through the left ear only.

We also failed to find a supression effect upon binaural presentation. We recognize the limitations of this study in the number of subjects, and in no clear distinction in lesion sites or types, but if our results are generalizable, we would advise caution in the clinical implementation of previous suggestions on ear effect. In other words, if you have been fitting aphasic subjects with head-sets and channeling all messages through the left ear, perhaps at this point in time, we should remove them.

We would like to reaffirm, however, the need for further exploration of the relationships among ear presentation, site of lesion, type of auditory stimuli, and the quality and severity of aphasia.

Only through furthering our knowledge of this most important area of aphasia symptomatology, can we expect to hone our therapeutic efforts to their finest edge.

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Discussion

Q. Did anybody show better performance with the left ear? (Dr. Rubens then outlined some of the findings in his research related to site of lesions and ear preference in dichotic tests.)

A. That is an interesting way to look at it. In our study as I recall there were one or two subjects who had slightly better scores in the left ear but essentially the left and right ear scores were equal.

Q. If you had patients who reflected the higher levels of overall communication on the PICA, perhaps that explains why no ear effect was found. Maybe the effect only exists in severely involved patients.

A. Perhaps so, though we did have several subjects with rather low PICA overall scores.

Q. Maybe your stimuli should have included material that was more conducive to imaging.

A. Maybe. Imagination is funny. It makes a cloudy day sunny.

Q. Please review the nature of the stimuli in the other studies.

A. In the studies cited, they used single word stimuli and a matching task. They were similar to the Peabody Picture Vocabulary test pictures. Single words, both nouns and verbs. In our case we used items in the Token Test from each of the subsections. We attempted to see if the ear effect existed using more complex strings of material.