Training an Aphasic Adult to Respond Appropriately to Spoken Commands by Fading Pause Duration Within Commands.

Anthony P. Salvatore

Veterans Administration Hospital
Minneapolis, Minnesota 55417

Perhaps the most dominant characteristic of aphasia is impaired ability to respond appropriately to spoken messages. Spoken messages must be understood as they are presented in real time. The aphasic individual's impaired ability to respond appropriately to spoken messages may be related to the temporal characteristics of the message. For example, when aphasic subjects are asked to report the order of sequences of pure tones (Belmont and Handler, 1971; Edwards and Auger, 1965; Efron, 1963; Swisher and Hirsh, 1972; and Teuber, 1962), or to discriminate between phonemes (Ebbins and Edwards, 1967), their performance improves if the interval between the stimuli to be discriminated is increased. Similarly, carrying out spoken commands is facilitated by increasing the pause duration within the command (Lasky and Weidner, 1974; Liles and Brookshire, 1975; Salvatore, 1974). In general, then, aphasics' ability to process acoustic stimuli is facilitated by increasing the amount of unfilled time within sequences of acoustic stimuli.

The reports of Liles and Brookshire (1975) and Salvatore (1975) suggest that exposure to long pauses may have valuable treatment potential. Liles and Brookshire found that 5-sec pauses were more facilitating than 0.5-sec pauses when inserted within commands similar to those in the Token Test (De Renzi and Vignolo, 1962). Furthermore, their subjects also tended to make more correct responses in a 0.5 sec-pause condition following exposure to a 5-sec pause condition. These findings suggest that exposure to a long pause may facilitate performance at a shorter pause duration. Following up on this possibility, Salvatore (1975) investigated the effectiveness of training based on the insertion of pauses within commands similar to those used by Liles and Brookshire. In the training procedure, aphasic subjects were exposed to commands at each of four pause durations (4, 2, 1, 0.5 seconds). The Training Group received the training procedure between administration of a pre- and post-test. The pre- and post-tests each consisted of two administrations of commands containing two pause durations (2 and 0.5 seconds) inserted in the commands. The No Training Control Group received the same pre- and post-tests, but not the training pauses. A third group, the No Pause Control Group received only pre- and post-tests containing no inserted pause time. The Training Group and the No Training Control Group showed a significant reduction in error responses from pre- to post-test. The post-test improvement for these groups was shown in both 2-sec and 0.5-sec pause; however, the subject always made fewer errors in the 2-second condition than in the 0.5-sec pause condition. These results further substantiate the findings of Liles and Brookshire. Furthermore, the lack of improvement for the No Pause Control Group suggests that mere exposure to the pre- and post-test commands could not explain the improvement of the other two groups. These results suggest that exposure to long pauses not only improves performance on commands containing long pauses, but also improved performance on commands containing shorter pauses.

The treatment implications of these data seem straightforward. Since an aphasic subject responds correctly to spoken commands containing long pauses, but not as successfully to commands with minimum pause time, the task is to maintain the accuracy of responding from the long pause to shorter pause durations. Previous laboratory (Moore and Goldiamond, 1964; Ray, 1967; Salvatore, 1969; Sidman and Stoddard, 1967; Stoddard and Sidman, 1967; Terrace, 1963a; Terrace, 1963b; Touchette, 1968; Westbrook and Miles, 1970) and clinical evidence (McLean, 1970) indicates that the manipulation of the antecedent or input stimulus is an effective teaching technique. Stimulus shaping or fading begins with the reinforcement of a response in the presence of one stimulus condition, then gradually shaping or manipulating the stimulus until the same response occurs in a different stimulus condition in which the subject did not previously make the response. Applying this shaping technique to pause duration may result in the aphasic subject responding correctly to commands containing no pause time. That is, by gradually reducing the duration of the pause, the subject's correct responding to spoken commands with long pauses may be shifted to commands containing no pause time. Furthermore, the gradual reduction of pause duration may reduce the occurrence of errors, thus providing the subject with a high rate of success.

The clinical relevance of this stimulus shaping procedure depends on the reliable presentation of the pause duration with live voice. Live voice administration provides the clinician with flexibility to change the duration of the pause during a session that tape-recorded stimuli does not provide.

Method

Subject

The subject was a fifty-year old, left-handed male diagnosed as aphasic with right hemiparalysis, right homonymous hemianopia and diplopia secondary to a gunshot wound to the left parietal area suffered 10 years prior to this investigation. The subject was comatose for two months following his accident. Prior to his accident, he was an insurance underwriter with a B.S. degree in engineering.

The subject was seen periodically for speech and language treatment following his accident but had not been treated for a year prior to the present study. The Porch Index of Communicative Ability, administered three months prior to this study, showed an overall percentile score of 75 (Gestural, 68th percentile; Verbal, 53rd percentile; Graphic, 88th percentile). A Nelson Reading Test, administered two years prior to this study, showed a grade equivalent of 4.5 on the vocabulary portion, and a paragraph comprehension grade equivalent of 2.7. The subject's auditory acuity was within normal limits for frequencies 500, 1000 and 2000 Hz (Re: ISO 1964).

Setting and Aparatus

Sessions were carried out in a single-wall, two room IAC audiometric suite. The examination room contained a table and chair. An intercom and a window between the two rooms permitted communication between the rooms. An Altec 682 microphone was mounted over the table and connected to the input of a Sony TC-650 tape recorder in the adjoining room.

Test tokens were arranged in horizontal rows on a wood response board. A hinged cover allowed the examiner to cover and uncover them. A red signal light was placed on the table to the left of the response board. The light was controlled by a foot-operated push-button which was located under the table on the floor.

Materials

Spoken commands used were similar to those found in the Token Test (DeRenzi and Vignolo, 1962). The task of the subject was to point to or manipulate tokens of various colors (green, yellow, blue, white, red) and shapes (squares, circles) in response to commands spoken by the examiner. There were five parts to the Token Test. Within each of Part I through Part IV were ten commands of identical length and grammatical structure. In Part V, there were twenty-two commands which varied in length and structure. An example from each part is provided below:

Part I	Touch the blue square.
Part II	Touch the big green circle.
Part III	Touch the yellow square and the white circle.
Part IV	Touch the little red circle and the big red square.
Part V	Put the green circle under the blue square.

Procedures

The subject sat at the table and the examiner sat at his right. The subject was instructed that he would hear a spoken command and that he was to carry out the command. The subject had unlimited time to respond, and a command was presented only once. After a command was presented, the subject's response was recorded on a score sheet. Each correct response was immediately followed by the examiner saying "good," "nice," or "fine," while an error response was followed by the examiner recording the response and going on to the next command. An observer in the adjoining room measured the examiner's pauses with a stopwatch. To indicate to the subject when to respond, the signal light was turned on by the examiner a few seconds before a command was presented and turned off immediately following the command. The subject was permitted to respond after the light was turned off.

Table 1 presents the sequence of procedures the subject experienced.

Baseline 1 Pre-Test - Taped Presentation

The standard Token Test was administered to determine at what level of command complexity the subject began to respond incorrectly. The level of complexity where the subject began to make errors would be used to determine where treatment would begin. The test was repeated over a number of sessions to ensure that the subject's performance was stable. The examiner said "good" or "fine" after each correct response. During Baseline 1, the commands were presented via audio-tape in order to ensure a consistent presentation of the commands from session to session. The commands contained no inserted pauses. The speaker was a female speech pathologist who spoke at a mean rate of 240 syllables per minute.

Table 2 shows the mean number of correct responses made in each part of the Token Test during taped presentation. These results show that the subject responded correctly to commands in Parts I and II of the Token Test, but responded incorrectly to commands in Parts III, IV, and V. This performance appeared to be stable across all sessions. Based on these results, a decision was made to focus training on Part III commands (e.g., "Touch the blue circle and the red square.").

Baseline 2 Pre-Test - Spoken Presentation

In order to determine the pause duration which would be used to begin training, an examiner presented Part III commands to the subject in live voice. Pauses of 4, 2, 1 and 0 seconds were inserted within the two phrases within the Part III commands (e.g., "Touch the blue circle (pause) and the red square."). Each pre-test session consisted of 40 commands divided into four sets of ten commands each. One pause duration was inserted in each of the ten commands in a set. Each set contained a different pause duration. The four pause durations were presented in a descending order (4, 2, 1 and 0 seconds) and an ascending order (0, 1, 2 and 4 seconds) across the sets of commands. These sets of commands were repeated over a number of sessions to ensure that the subject's performance was stable. The duration of the pause was controlled by the examiner counting silently to himself (a 1-sec pause was accomplished by counting "one-thousand-one", and so forth). Each correct response was followed by verbal praise. Figure 1 shows the average number of correct responses made to Part III commands at each of the four pause durations. The subject made more correct responses when a 4-sec pause was inserted within the command than in any of the other pause conditions. Based on these data, training began with a 4-sec pause inserted in commands.

Training Procedure

Training was carried out over 52 sessions. Sessions were conducted three times a week; each session lasted approximately 35 minutes. A training session consisted of four sets of ten training commands, plus four "training probes," ten "generalization commands" and a number of "baseline probe commands" as required by the subject's performance (to be described later). A description of the training procedures are presented below.

Pause Fading

The basic procedure in training was the gradual reduction of pause duration. Pause duration was manipulated by the examiner depending on the subject's success of failure in responding to commands containing a training pause. If the subject met the success criterion (described in "Results"), the duration of the pause was reduced in the next set of training commands. When the subject failed to meet the success criterion, the duration of the pause was increased in the next set of training commands. The success criterion was modified to facilitate the subject's successful progression through training.

Each correct response was followed by verbal praise. The tokens were visually accessible to the subject while each training command was presented to the subject by the examiner.

Table 1. Sequence of procedures the subject experienced.

1. Baseline

   a. Baseline 1 pre-test: Token Test via audio-recording.
   b. Baseline 2 pre-test via live voice.

2. Training Via Live Voice

   a. Pause fading
   b. Pause fading and gestured prompt
   c. Pause fading
   d. Pause fading and examiner reliability

3. Post-Training Baseline

   a. Baseline 1 post-test
   b. Baseline 2 post-test
   c. Retention Test-Baseline 2

Table 2. Percentage of commands responded to correctly during Baseline 1 pre- and post-test delivered via audio-recording.

	Baseline 1				
	TOKEN TEST PARTS				
Baseline Sessions	I	II	III	IV	V
Pre-Test					
1	100	60	10	-	14
2	90	90	0	10	14
3	90	80	0	20	14
4	90	90	0	20	18
Post-Test					
1	90	90	10	0	14

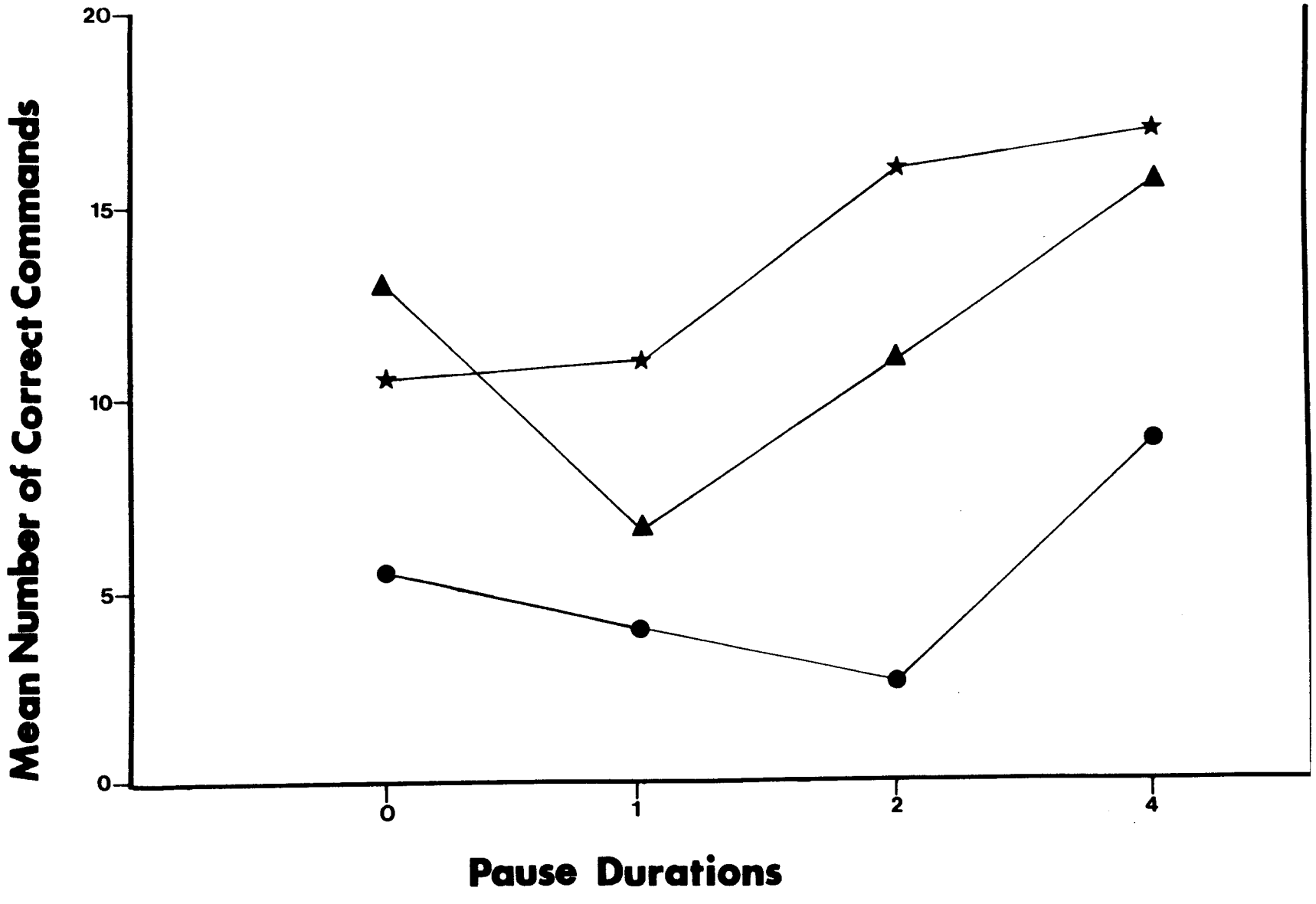

Figure 1. Mean number of correct responses made by the subject to commands at each pause condition during Baseline 2 pre-test (o——o), post-test (*---*) and retention test (Δ——Δ).

Baseline Probe

To ensure the subject's error responses were not due to forgetting the task instruction or to fatigue, and to break up the occurrence of strings of error responses during training, a command from Part I of the Token Test (e.g., "Touch the red circle.") was presented whenever two consecutive error responses occurred. Part I commands were used as baseline probes (Salvatore, 1972) because Baseline 1 pre-test results indicate that the subject almost always responded correctly to them. While the probe was administered, tokens were covered and uncovered immediately after it was presented. Every correct response to the probe was followed by verbal praise. Following a probe, the next training command was presented.

Training Probe

After each set of ten training commands, a training probe was presented. Training probes were Part III commands which were different than any of the commands used during training. The probe command contained no inserted pause. During presentation of the probe command the tokens were covered. Immediately after the probe was presented, the examiner uncovered the tokens, permitting the subject to respond. The examiner provided no feedback to the subject following the subject's response to the probe. After a three-minute break following the subject's response, the next set of training commands was presented.

The training probe was used to evaluate the effects of the training procedure in transferring the subject's correct responding from training commands containing a pause to similar commands that did not contain a pause.

Generalization Commands

Following the administration of the four sets of training commands, ten generalization commands were administered. These Part V commands were selected because the subject never responded correctly to them during the administration of Baseline Condition 1. No pause time was inserted within these commands. Tokens were covered during the presentation of a command and uncovered immediately after a command was presented. The examiner did not provide feedback following the subject's response.

Generalization commands were used to determine the effectiveness of training in transferring the subject's correct responding from training commands to commands that were different from and more complex than those used in training.

Baseline 1 Post-Test - Taped Presentation

The audio-recording of the standard Token Test used in Baseline 1 Pre-Test was administered in the session following termination of training. This test was administered to determine the effectiveness of training on the test.

Baseline 2 Post-Test - Spoken Presentation

On a subsequent session, a test was administered to evaluate the effectiveness of training on the four pause durations tested in Baseline 2 Pre-Test. This test was administered in the same manner as Baseline 2 Pre-Test; however, the commands used were different than those used in the Pre-Test, to minimize any practice effects.

Retention Test - Spoken Presentation

Twelve weeks following the administration of Baseline 2 Post-Test, it was administered again to measure whether the subject's performance during training would persist following training.

Accuracy of Examiner's Pausing Behavior

During training an observer measured the duration of the examiner's pauses with a stopwatch. These measurements were later compared with measurements made from graphic level recordings. The graphic level recordings were made from audio-recordings of the training sessions.

Results

Baseline 1 Pre- and Post-Tests - Taped Presentation

Training had no effect on the subject's response to Part III commands containing no pause time when presented via audio-tape. Performance on the post-test did not differ from performance on the pre-test, as shown in Table 2.

Baseline 2 Pre- and Post-Tests - Spoken Presentation

Shown in Figure 1 are the mean number of correct responses made by the subject during the pre- and post-tests of Baseline 2 (Part III commands presented via live voice with inserted pause time). On the post-test the subject showed greater increase in correct responses in the 2-sec and 4-sec pause conditions than in the 1-sec and no pause conditions. The greatest increase in correct responses between the pre- and post-test occurred within the 2-sec pause condition.

The reduction of errors within the 0- and 1-sec pause conditions suggests a transfer of the subject's successful performance from training to the shorter pause durations within this post-test. The successful transfer of performance shown in this post-test at the 0-sec pause was not shown in Baseline 1 post-test, which contained commands with no inserted pause time. To determine the possible source of this discrepancy, the rate of speech of the speaker on the audio-recording used for Baseline 1 and of Examiner 1 (in Baseline 2) were measured. The audio-recording used for Baseline 1, and the audio-recordings of Examiner 1 during Baseline 2 sessions were played into a General Radio 1523 graphic level recorder. The graphic level recorder generated a graphic record of each command as it was delivered by each speaker. These commands were measured in inches, transformed to time and computed into seconds. Then pause durations of 250 msec

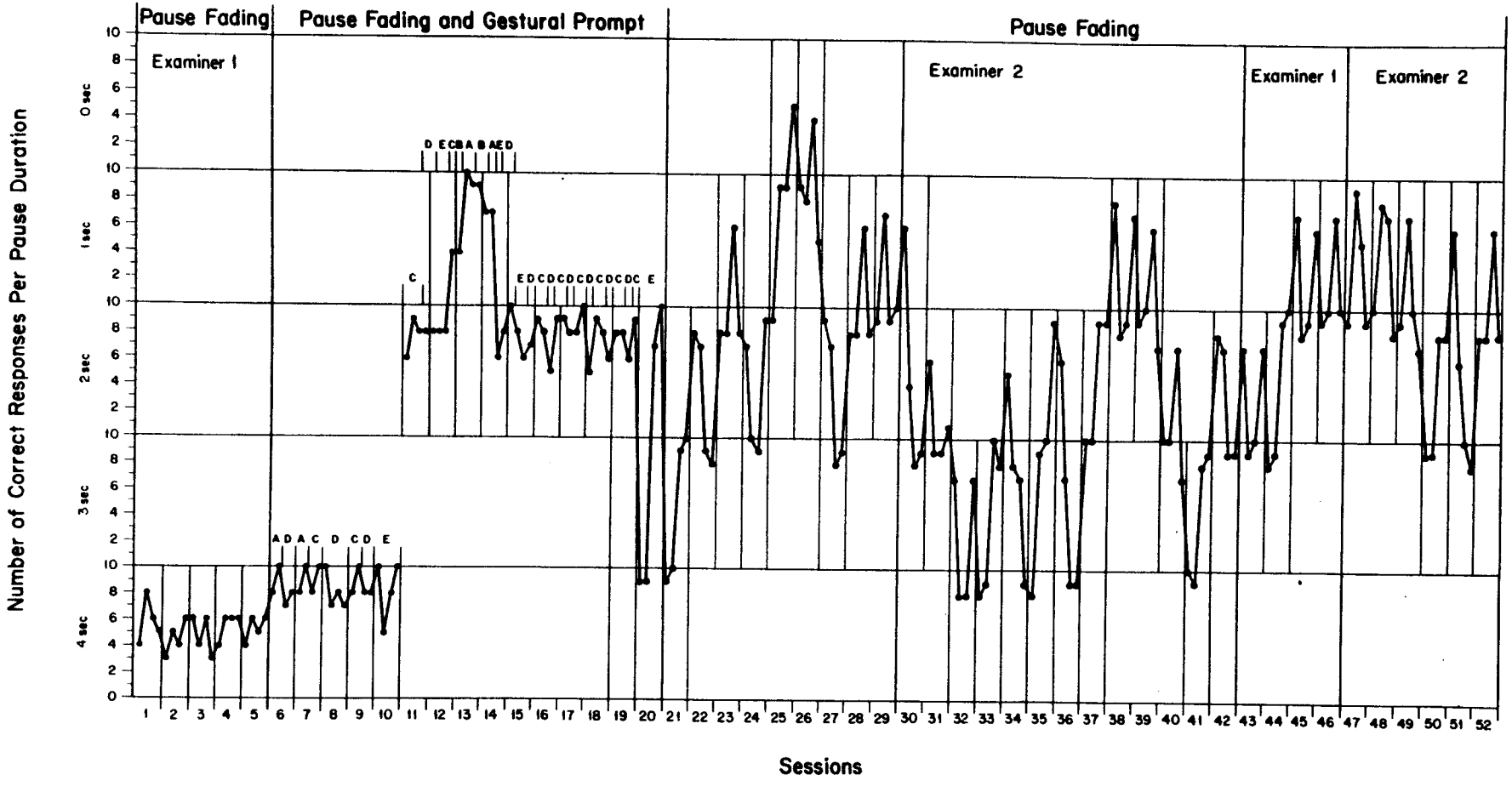

Figure 2. Number of correct responses made by subject to training commands in each pause condition and training condition. An upward movement towards a shorter pause duration, and an upward movement within each pause condition indicates successful performance. The gestural prompt steps are indicated by letters A through E and are placed above the appropriate training command set.

or greater (pauses less than 250 msec were difficult to measure reliably) were subtracted from the total duration of the command in which that pause (s) occurred. The resulting time was considered "articulation time" for that command. The articulation times from each of the two speakers were then compared, using a two-tailed student's t-test. The t-test comparison indicated that the two speakers spoke at significantly different rates of speech ($t=2.35$; $df=8$; $p < .05$). These articulation times were then transformed to syllables spoken per minute. The speaker on the audio-recording used in Baseline 1 spoke on the average at 240 syllables per minute, while Examiner 1 (during the Baseline 2 Post-Test) spoke on the average at 200 syllables per minute during Baseline 2 Post-Test. Since the speaker on Baseline 1 spoke at a significantly faster rate than Examiner 1, this difference in rate of speech may explain the lack of transfer of the subject's correct responding to Baseline 1 commands which contained no inserted pause time.

Retention Test: Baseline 2

Twelve weeks after the administration of Baseline 2 Post-Test, it was administered again to determine the long-term effects of training. Performance on the retention test was better than the Baseline 2 pre-test, but less accurate than Baseline 2 post-test (Figure 2). The interesting result is the subject's performance on commands containing no pause time. While the 4-sec pause condition continued to provide the best performance, the 0-sec pause condition was better than the 2-sec and 1-sec pause conditions.

Training Procedure

The number of correct responses for each set of training commands per pause duration and examiner is shown in Figure 2. Upward movements within and across pause durations indicate correct responses, while downward movements indicate incorrect responses.

Pause Fading: Sessions 1 through 5

During the first 11 sessions the success criterion was 80% correct responding within each of two consecutive sets of commands. The subject did not meet criterion during the first five sessions at the 4-sec pause duration. He responded correctly to an average of only five of the ten commands per training set during these sessions.

Pause Fading Plus Gestural Prompt: Sessions 6 through 20

During the first five sessions, the subject responded incorrectly to the first of the two tokens specified more frequently. A gestural prompt was instituted beginning with session 6 to direct the subject's attention to the first token. The prompt was gradually removed in the following manner: (a) the examiner pointed to the first token in the command; (b) the examiner gestured to the first token plus a token to its left and right; (c) the examiner made a general gesture over the row in which the first token was located; (d) the examiner gestured over both rows of tokens; (e) the examiner made no prompt.

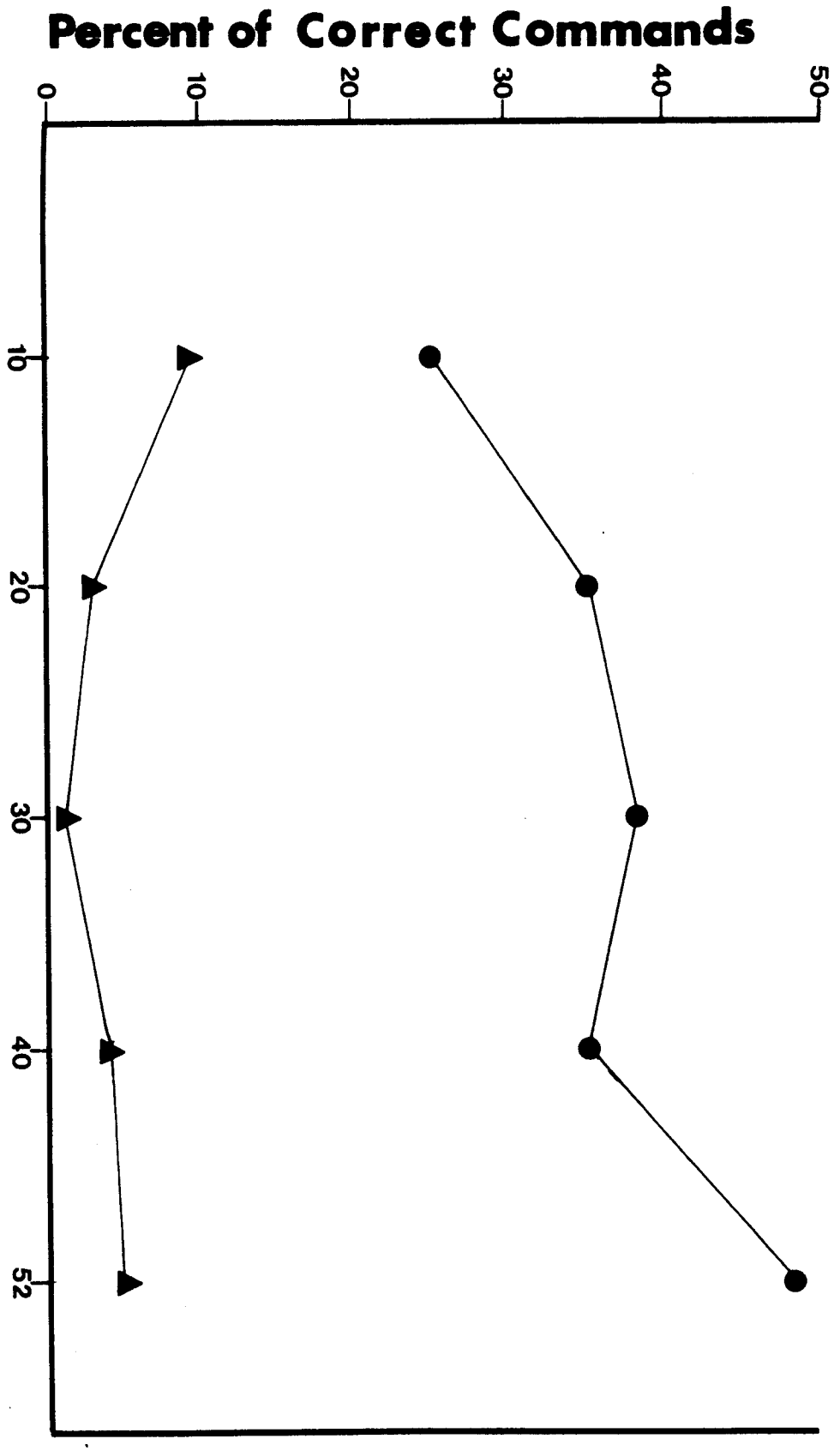

Figure 3. Percentage of correct responses made by the subject to training command probes (o——o), generalization commands, (Δ——Δ), averaged over blocks of ten sessions, except for the last twelve sessions which were averaged.

As Figure 2 shows, the subject proceeded successfully through the 4-sec pause and 2-sec pause conditions and all steps of the gestural prompt. Within the 1-sec pause condition, the subject did not meet the success criterion and was returned to the 2-sec pause condition where he responded correctly.

During sessions 15-20 the subject did not reach criterion. In session 11, however, he had had little difficulty with the same training conditions. His performance during sessions 15-20 suggested that the gestural prompt was not facilitating his progress. The use of the prompt was, therefore, discontinued after session 20. The subject was returned to a 4-sec pause condition to reestablish his successful performance, and a 3-sec pause condition was added in order to make the transition from 4- to 2-sec more gradual. Beginning with session 12 the subject was required to respond correctly to 80% of the training commands, or two consecutive sets of commands, whether or not it was accomplished within one session. This change reduced the number of sessions without substantially weakening the criterion.

Pause Fading: Sessions 21 through 52

Beginning with session 21, pause duration was gradually reduced from 4 to 3 to 2 to 1 to 0 seconds, as the subject achieved criterion at each step. During session 21 through 29, the subject achieved criterion within pause lengths of 4, 3, and 2 seconds. Although the subject encountered 1- and 0-sec durations, his performance was more stable in the 2-sec pause condition than at 1- and 0-sec.

Pause Fading: Sessions 30 through 42

To determine whether the subject's performance could be maintained with a second examiner, and also to determine whether a second examiner could pause reliably during treatment, the Observer and Examiner changed roles. Examiner 2 worked with the subject from Sessions 30 through 42. Figure 2 shows that Examiner 2 initially (Sessions 30-33) had difficulty in maintaining the subject's performance at the 2-sec pause. Examiner 2 was more successful at maintaining a high rate of success with the subject in the 3-sec pause, while the subject did progress occasionally into the 2- and 1-sec pause conditions.

Pause Fading: Sessions 42 through 46

Examiner 1 replaced Examiner 2 beginning with the 43rd session and Examiner 2 took over the role of Observer. Examiner 1 again generated and maintained successful and stable performance by the subject at the 2-sec pause condition. During sessions 42 and 44 the subject did not successfully progress into the 2-sec pause condition, but in sessions 45 and 46 the stability of the subject's performance during the 2-sec pause is clear (Figure 2.)

Pause Fading: Sessions 47 through 52

During these sessions, Examiner 2 was able to match the performance of Examiner 1 in generating successful and stable performance by the subject at the 2-sec pause condition. Although the subject made excursions into 1-sec

pause condition, in addition to backing up into the 3-sec pause condition, the subject performed successfully during more sets in the 2-sec pause condition than in the other pause conditions.

In general, the subject was not able to proceed beyond the 2-sec pause condition consistently. Overall, the subject was more successful in the 4, 3, and 2-sec pause conditions than at the 1- and 2-sec pause conditions.

Baseline Probe

During training, 92 baseline probes were administered following the occurrence of two consecutive error responses. The probes were responded to correctly in 91 of the 92 presentations. Eleven of the 92 probes were followed by an error on the subsequent training command.

Training Probes and Generalization Commands

Figure 3 shows a gradual increase in correct responses to the Part III training command probes, which contained no pause time. There is, however, no overall increase in correct responses to the generalization commands, which also contained no pause but were more complex commands.

Stability of Subject's Behavior Across Examiners

Table 3 shows the percentage of sets of training commands administered to the subject at each pause condition by each of the two examiners. These measurements were taken from Sessions 2- through 52, since both examiners took part in the same training procedure during those sessions. Examiner 1 administered a greater percentage of sets of training commands containing a 2-sec pause than sets of commands containing any of the other pause conditions. Initially (sessions 30-42) Examiner 2 administered a greater percentage of sets of training commands containing a 3-sec pause; however, he later (sessions 47-52) administered more sets of training commands with a 2-sec pause. These results indicate that the subject was able to perform similarly with both examiners after Examiner 2 gained more experience with the subject.

Accuracy of Examiners' Pausing Behavior

Table 4 shows the means and standard deviation of pause durations for each examiner during administration of training commands as measured by an observer. An examination of Examiner 1's pausing behavior indicates that he was very accurate in producing a required pause duration. Examiner 2's pausing behavior became more accurate as he gained experience with the procedure. Examiner 2's initial inaccuracy might explain why the subject performed poorly during session 30-33.

Reliability of Observers' Measurements of Examiners' Pausing

The reliability of the Observers' measurement of the examiners' pausing behavior was assessed. The assessment was accomplished by randomly selecting 70 pause measurements recorded by each observer during training. Audio-recordings made of the commands containing those 140 pauses were passed

Table 3. Percentage of training command sets delivered at each pause condition by each examiner in Sessions 20 through 52.

		PAUSE DURATIONS				
		4 Sec.	3 Sec.	2 Sec.	1 Sec.	0 Sec.
Examiner	Training Sessions					
1	20 - 29	5.7	22.8	45.7	20.0	5.7
2	30 - 42	18.8	41.5	32.0	7.5	0.0
1	43 - 46	0.0	26.6	53.3	20.0	0.0
2	47 - 52	0.0	16.0	56.0	28.0	0.0

Table 4. Means and standard deviations of the duration of pauses produced by each examiner at each pause condition.

	PAUSE DURATIONS			
	4 Sec.	3 Sec.	2 Sec.	1 Sec.
Examiner 1		$\bar{X}$ - 3.00	$\bar{X}$ = 2.02	$\bar{X}$ = 1.04
		SD = .04	SD = .04	SD = .04
Examiner 2	$\bar{X}$ = 4.08	$\bar{X}$ = 2.80	$\bar{X}$ = 2.07	$\bar{X}$ = 1.07
	SD = .06	SD = .56	SD = .05	SD = .05

into a graphic level recorder. Measurements recorded by the observers and the measurements made from the graphic record were compared. A Pearson Product Moment Correlation (Hayes, 1973) indicates that a correlation of .94 was obtained. The measurements made by Observer 2 of Examiner 2's pausing behavior indicate the observer's measurements were also highly correlated (r=0.97) with their graphic counterpart.

Discussion

This study attempted to improve an aphasic individual's comprehension of spoken commands by gradually reducing the duration of pauses within these commands. The subject was given training in which he was required to point to tokens in response to commands containing inserted pause time. By gradually reducing the duration of the pause, it was hypothesized that the subject would transfer correct responding from commands containing a long pause to commands containing no inserted pause time. Data were also gathered to investigate clinicians' ability to reliably produce accurate pause duration during administration of training commands. In general, the results were encouraging.

During training the subject successfully proceeded from commands containing a 4-sec pause to commands containing a 2-sec pause; and even to some commands containing a 1-sec pause. However, the subject did not consistently respond correctly to commands containing pauses of less than 2 seconds, suggesting a "threshold". One explanation for the effect of pauses is that it functions as a cue for "chunking" a command into smaller bits of information, thus facilitating comprehension. If the pause functioned solely as a chunking cue, then we would expect the subject to succeed eventually in the 0-sec pause condition. Since the subject did not proceed beyond the 2-sec pause it appears that, for this subject at least, the pause may have functioned as time for "processing" the preceeding verbal stimuli. The facilitating effect of a long pause in spoken commands found in this study replicates and extends the earlier findings of Lasky and Weidner (1975), Liles and Brookshire (1975), and Salvatore (1974, 1975).

Baseline 1 - Taped Presentation

A comparison of pre- and post-test performance during taped presentation of the Token Test shows little difference. These data suggest that training had no effect on the subject's performance on tape-recorded commands containing no pauses. This lack of transfer was discouraging, but appeared consistent with the subject's inability to process commands containing pauses less than 2 seconds in duration during training.

Baseline 2 and Training Probes - Spoken Presentation

The subject's overall increase in correct responses from pre-test to post-test on spoken commands is encouraging. Especially encouraging is the improvement shown on commands containing a 1-sec and 0-sec pause during the post-test. Since commands used in the post-test and probe conditions were not used during pre-test and training the subject's improvement cannot be attributed to previous exposure to these commands. These results offer support for the effectiveness of training in transferring the subject's successful performance on training commands to commands containing little or no inserted pause time.

The subject's successful performance on spoken commands during Baseline 2 post-test and training command probes is at odds with the lack of success on similar commands (Part III) presented via audio-recording in Baseline 1 pre- and post-test. When presenting training commands the examiner spoke an average of 224 syllables per minute, while during Baseline 2 the second examiner spoke at an average of 200 syllables per minute. This difference in speech rate may be one explanation for the discrepancy. The significance of speech rate as a factor in an aphasic individual's comprehension of spoken commands has been previously reported by Parkhurst (1970), Gordon (1970), and Lasky and Weidner (1976). Earlier Green and Boller (1974) reported a discrepancy between an aphasic individual's performance in responding to verbal stimuli presented via audio-recording compared to live voice presentation; however, they failed to provide data to explain the discrepancy.

A final comment about the subject's successful transfer from training commands to untrained spoken commands on Baseline 2 and Training Probes is necessary. An earlier study reported by Holland and Sonderman (1974) failed to show significant transfer from training commands to untrained commands. The difference in results between the two studies might be due to the fact that Holland and Sonderman manipulated command complexity while the present study manipulated pause duration, holding complexity constant.

These findings appear to have clinical application for counseling people who are active in the aphasic individual's living situation. If a clinician can determine the most facilitating pause duration then those people who deal with the individual can be advised about how to use pauses to improve communication.

Retention Test: Baseline 2

The improved performance on the retention test over the subject's pre-test performance suggest long term benefits of training. Gains made in training were still evident twelve weeks after training had ended. These results are important since few data have been reported on long-term effects of training procedures designed to improve the aphasic's comprehension of spoken commands.

Baseline Probe

On the Baseline Probe commands, the subject demonstrated a high rate of success. The subject's almost errorless performance on these probes suggests: (1) The subject understood the task requirements of pointing to tokens in response to spoken commands. (2) The subject's error responses to training commands preceeding the probe were not a function of fatigue. (3) The subject's errors could not be ascribed to a simple "auditory perceptual deficit." Finally, the subject responded correctly to 88 per cent of the training commands following the baseline probe trials. This finding suggests responding to a simpler command improved his performance on the subsequent more complex command.

Training Examiners

The results of this study also suggest that clinicians can successfully insert pauses within spoken commands live voice, thus allowing the clinician considerably more flexibility than can be accomplished with audio-recordings. The capacity for such accuracy will also permit the clinical application of pause fading in treatment and experimentation. The two examiners in this study practiced their pausing behavior before the study was begun. The establishment of such proficiency appears crucial since research (Salvatore, Strait and Brookshire, 1975) has shown that in clinical situations clinicians vary in their use of pausing when administering spoken commands to aphasic subjects.

Bibliography

Belmont, I., Handler, A., Delayed information processing and judgement of temporal order following cerebral damage. J. Nervous and Mental Disorders, 152, 353-361, 1971.

DeRenzi, E., Vignolo, L.A., The Token Test: A sensitive test to detect receptive disturbances in aphasia. Brain, 85, 556-678, 1962.

Ebbins, J.B., Edwards, A.E., Speech sound discrimination of aphasics when intersound interval is varied. J. Speech and Hearing Research, 10, 120-125, 1967.

Edwards, A.E., Auger, R., The effects of aphasia on the perception of precedence. Proceedings of the convention of American Psychological Association, 207-208, 1965.

Efron, R., Temporal perception, aphasia and dejà vu. Brain, 86, 403-424, 1963.

Gordon, M.C., Some effects of stimulus presentation rate and complexity on perception and retention in brain-damaged patients, Cortex, 6, 273-286, 1970.

Green, E., Boller, F., Features of auditory comprehension in severely impaired aphasics. Cortex, 12, 133-145, 1974.

Holland, A.L., Sonderman, J., A program for training comprehension skills based on the Token Test. J. Speech and Hearing Research, 17, 589-598, 1974.

Lasky, E.Z., Weidner, W.E., Johnson, J., Influence of linguistic complexity, rate of presentation, and interphrase pause time on auditory-verbal comprehension of adult aphasics. Convention Program Summary, American Speech and Hearing Association, 89, 1974.

Liles, B.Z., Brookshire, R.H., Effects of pause time on auditory comprehension of aphasic subjects. J. Communication Disorders, 8, 221-236, 1975.

McLean, J.E., Extending stimulus control of phoneme articulation by operant techniques. American Speech and Hearing Monograph, No. 14, 1970.

Moore, R., Goldiamond, I., Errorless establishment of visual discrimination using fading procedures. J. Experimental Analysis of Behavior, 7, 269-272, 1964.

Nelson, M.J., The Nelson Reading Test. New York: Houghton-Mifflin, 1962.

Parkhurst, B.G., The effect of time altered speech stimuli on the performance of right hemiplegic adult aphasics. Convention Program Summary, American Speech and Hearing Association, 12 (9), 440, 1970.

Porch, B.E., The Porch Index of Communicative Ability. Palo Alto, California: Consulting Psychologists Press, 1971.

Ray, B.A., The course of acquisition of a line-tilt discrimination by rhesus monkeys, J. Experimental Analysis of Behavior, 10, 17-23, 1967.

Salvatore, A.P., A comparative analysis of two instructional programs designed to teach children to differentially respond to an auditory stimulus. Unpublished master's thesis, Emerson College, Boston, 1969.

Salvatore, A.P., Use of a Baseline Probe Technique to monitor the test responses of aphasic patients. J. Speech and Hearing Disorders, 37, 471-475, 1972.

Salvatore, A.P., An investigation of the effects of pause duration on sentence comprehension of aphasic subjects. Unpublished doctoral dissertation, University of Pittsburgh, 1974.

Salvatore, A.P., The effects of pause duration on sentence comprehension by aphasic individuals. Convention Program Summary, American Speech and Hearing Association, 115, 1975.

Salvatore, A., Strait, M., Brookshire, R., Effects of patient characteristics on delivery of the Token Test command by experienced and inexperienced examiners. Proceedings of Clinical Aphasiology Conference, 103-112, 1975.

Sidman, M., Stoddard, L.T., The effectiveness of fading in programming and simultaneous form discrimination for retarded children. J. Experimental Analysis of Behavior, 10, 3-15, 1967.

Stoddard, L., Sidman, M., The effects of errors on children's performance on a circle-ellipse discrimination. J. Experimental Analysis of Behavior, 10, 261-270, 1967.

Swisher, L.P., Hirsh, I.J., Brain damaged and the ordering of two temporally successive stimuli. Neuropsychologia, 10, 137-152, 1972.

Teuber, J., Effects of brain wounds implicating right and left hemisphere in man, Interhemisphere Interactions and Cerebral Dominance, Baltimore, John Hopkins Press, 1962.

Terrace, H.S., Discrimination learning with and without "errors". J. Experimental Analysis of Behavior, 6, 1-27, 1963a.

Terrace, H.S., Errorless transfer of discrimination across two continua. J. Experimental Analysis of Behavior, 6, 223-232, 1963b.

Touchette, P.E., The effects of graduated stimulus change on acquisition of a simple discrimination in severely retarded boys. J. Experimental Analysis of Behavior, 15, 347-354, 1971.

Weidner, W.E., Lasky, E.Z., The interaction of rate and complexity of stimulus on the performance of adult aphasic subjects. Brain and Language, 3, 34-40, 1976.

Westbrook, R., Miles, C., The effects of a fading procedure upon the acquisition of control by an overshowed auditory feature. J. Experimental Analysis of Behavior, 13, 179-185, 1970.

Acknowledgement

This research was supported by NICDS Post-Doctoral Fellowship 1F2ZNS00842-01, and by the Research and Education Committee, Minneapolis Veterans Administration Hospital. Appreciation is expressed to Bruce Hanson who served as an examiner and to Drs. Audrey Holland, Robert Brookshire and Paul Touchette, for editorial comments.