24. The Effects of a Time-Delay Procedure on Comprehension of Verb-Noun Commands in Severe Aphasia

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Impairment of auditory comprehension occurs in most aphasic persons and may range from a subtle processing deficit observable only during formal testing to a severe disturbance in which individuals are unable to identify common objects or follow simple commands (Davis, 1983; Rosenbek, LaPointe, & Wertz, 1989; Schuell, 1974). Regardless of the severity of the impairment, most approaches to treatment involve the manipulation of stimuli (e.g., linguistic, contextual) to facilitate comprehension of spoken messages (Marshall, 1986). For those individuals with severe auditory comprehension disorders, manipulating stimulus redundancy may be a particularly useful treatment strategy.

Experimental psychologists have investigated several training procedures designed to teach discriminations through transfer of stimulus control (Schreibman, 1975; Striefel, Bryan, & Aikins, 1974; Striefel, Wetherby, & Karlan, 1976; Touchette, 1971; Touchette & Howard, 1984; Whitman, Zakaras, & Chardos, 1971). These procedures include stimulus shaping, stimulus fading, and time-delay procedures.

The time-delay procedure (Striefel et al., 1974) appears to be inherently attractive for treating severely aphasic patients because (a) it is essentially an errorless procedure (Touchette & Howard, 1984), (b) it is similar to "deblocking" (Davis, 1983; LaPointe, 1985; Rao & Horner, 1978) in that it systematically pairs and fades stimuli based upon subjects' ability to respond to at least one stimulus, and (c) it has been reported to be effective in training auditory-verbal discriminations in mentally retarded children (Striefel et al., 1976).

Another method that is conducive to the systematic manipulation of stimulus variables, as well as to the measurement of acquisition and generalization effects of treatment, is matrix training (Goldstein, 1983, 1985; Thompson, 1989). Matrix training has been used with aphasic patients to facilitate verbal production of prepositional phrases (Thompson, McReynolds, & Vance, 1982) and gestural production of verb-noun combinations (Tonkovich & Loverso, 1982) but has not been employed in the treatment of auditory comprehension disorders.

In the current investigation, a time-delay procedure was applied within a matrix training paradigm to examine its effects on comprehension of verb-noun commands in aphasic subjects with severe auditory comprehension deficits. The combination of these two methods allowed for a systematic examination of the transfer of stimulus control from a visual to a verbal modality and of the generalization effects of treatment.

METHOD

Subjects

Four male veterans between 61 and 64 years of age with nonfluent aphasia and severe auditory comprehension deficits participated in this study. They were all right-handed native speakers of English and ranged from 19 to 204 months post-onset of a single left-hemisphere cerebrovascular accident. All subjects passed a pure-tone audiometric screening at 30 dB HL at 500, 1000, and 2000 Hz bilaterally.

Subjects were administered the *Western Aphasia Battery* (*WAB*) (Kertesz, 1982) and the Shortened Version of the *Token Test* (DeRenzi & Faglioni, 1978). Their Aphasia Quotients ranged from 19.4 to 48.8 on the *WAB*. Subjects' performance on the *Token Test* ranged from 1 to 8, indicating that all subjects had severely impaired auditory comprehension.

Setting and Stimuli

Eight common objects served as stimuli. Each object was paired with four different verbs comprising two 4-by-4 matrices. Verbal stimuli consisted of low-probability verb-noun combinations spoken by the investigator: for example, *take-glove* or *cover-fork* (Figure 24.1).

Pretesting with the experimental stimuli established that subjects (a) could identify the common objects named by the investigator; (b) could not perform the verb actions in response to spoken commands such as "take it," "cover it," or "tap it"; and (c) could imitate all verb actions following a model by the investigator.

Matrix 1

	Glove	Plate	Book	Box
Take	T1	G	G	G
Rub	T2	T5	G	G
Circle	T3	G	G	G
Tap	T4	T6	T7	G

Matrix 2

	Fork	Pipe	Flower	Pen
Cover	T1	G	G	G
Slide	T2	G	G	G
Show	T3	G	G	G
Knock	T4	G	G	G

Figure 24.1. Matrices 1 and 2 for Subject 1. "T" cells indicate order of trained items and "G" cells indicate generalized items.

Experimental Design

A multiple-baseline design across behaviors (McReynolds & Kearns, 1983) was used to evaluate the acquisition and generalization effects of treatment.

Baseline

During baseline, subjects' ability to respond to all verb-noun commands was assessed. Four objects were presented at a time and the commands from each matrix were spoken randomly by the investigator. Subjects were given 5 seconds to respond. Responses were scored either correct or incorrect according to operational definitions. Once stable levels of response were achieved, treatment was initiated.

Time-Delay Procedure

Treatment was provided three times a week. Training began on the first two verb-noun commands on the vertical axis of Matrix 1. These verbal stimuli were spoken by the investigator, and their corresponding visual models immediately followed. There was no delay between the spoken command and the model of each verb-action. Following 10 trials at the zero delay level, a 1-second delay was introduced between verbal and visual stimuli. Following 10 consecutive error-free trials at the 1-second delay, the time interval was increased to 2 seconds and so on in 1-second increments. If the subject responded incorrectly within a designated time interval, the delay was reduced to the previous level at which errorless response was demonstrated.

Responses were scored (a) correct, if the subject responded accurately to the verbal command; (b) imitative, if the subject responded accurately following the investigator's model of the verb-action; and (c) incorrect, if the subject responded inaccurately. Training sessions consisted of 100 trials.

An acquisition criterion of a 90% correct response across three consecutive training sessions was preestablished. When this criterion was met, an additional verb-noun command was introduced into training.

Booster Training. This phase consisted of retraining all verb-noun commands previously targeted in Matrices 1 and 2. This training was administered prior to extramatrix generalization probes.

Generalization Probes

Two types of generalization probes were conducted: intramatrix and extramatrix. Intramatrix probes were identical to baseline procedures and were conducted following each treatment session in which 90% of the nonimitative training trials were scored correct. Once intramatrix generalization was evidenced across both matrices, extramatrix probes were conducted. In this condition, verbs from each matrix were combined with nouns from the opposing matrix to create novel verb-noun combinations.

Reliability

Interobserver reliability was calculated for scoring of subjects' responses for 33% of all baseline, training, and probe sessions for each subject. The percentage of agreement was calculated by dividing the total number of agreements by the number of agreements plus disagreements, and multiplying by 100. Agreement ranged from 98% to 100%. Reliability measures were obtained by a staff speech pathologist who was trained in the scoring procedure.

RESULTS

The percentage of correct nonimitative responses per training session for Subject 1 are shown in Figure 24.2. These data reveal that acquisition of

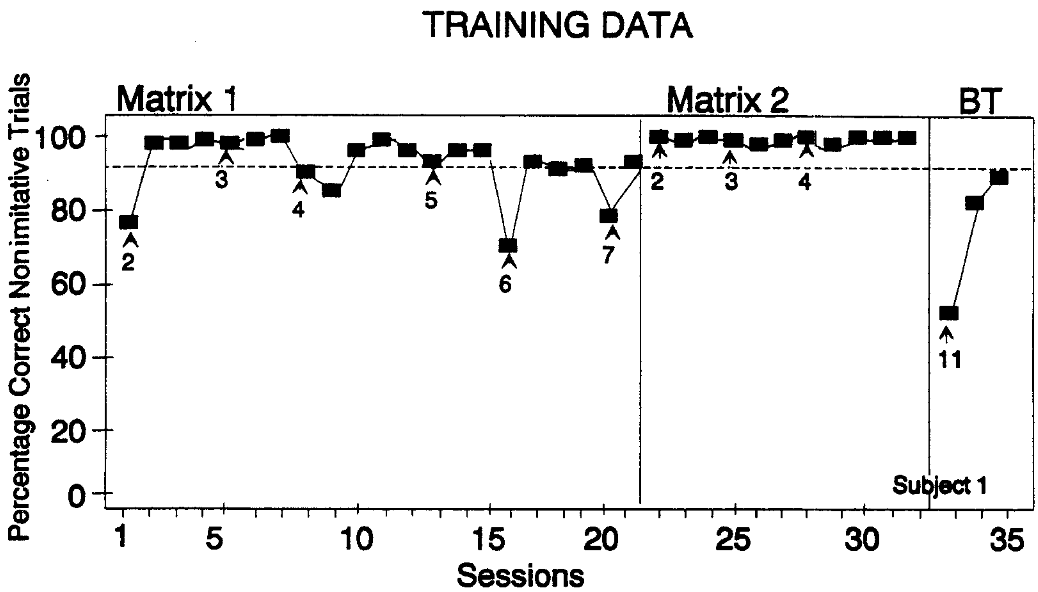

Figure 24.2. Percentage of correct nonimitative trials per training session for Subject 1. Arrows indicate the number of verb-noun commands being trained across sessions. The dotted horizontal line represents the established acquisition criterion level. "BT" indicates the booster training phase.

commands was rapid across both matrices. Subject 1 was trained on seven verb-noun commands in Matrix 1 and four verb-noun commands in Matrix 2. This required 21 and 11 training sessions for Matrices 1 and 2, respectively.

Figure 24.3 shows an analysis of Subject 1's training data according to the number of correct, imitative, and incorrect responses per training session. These data reveal that a minimal number of imitative trials were required to transfer stimulus control from the visual to the verbal modality.

Probe data for trained and untrained items from both matrices for Subject 1 are shown in Figure 24.4. These data reveal that generalization to untrained items occurred within both matrices and that the rate of generalization was more rapid for Matrix 2 items. Extramatrix generalization was observed following three additional training sessions in which all previously trained verb-noun combinations from both matrices were reentered into treatment.

The percentage of correct nonimitative trials per session for Subject 2 are shown in Figure 24.5. These data reveal variability in responses to initial verb-noun combinations within each matrix and an overall slower rate of acquisition than that observed for Subject 1.

The response analysis for Subject 2's training data is presented in Figure 24.6. These data show the variable relationship between imitative

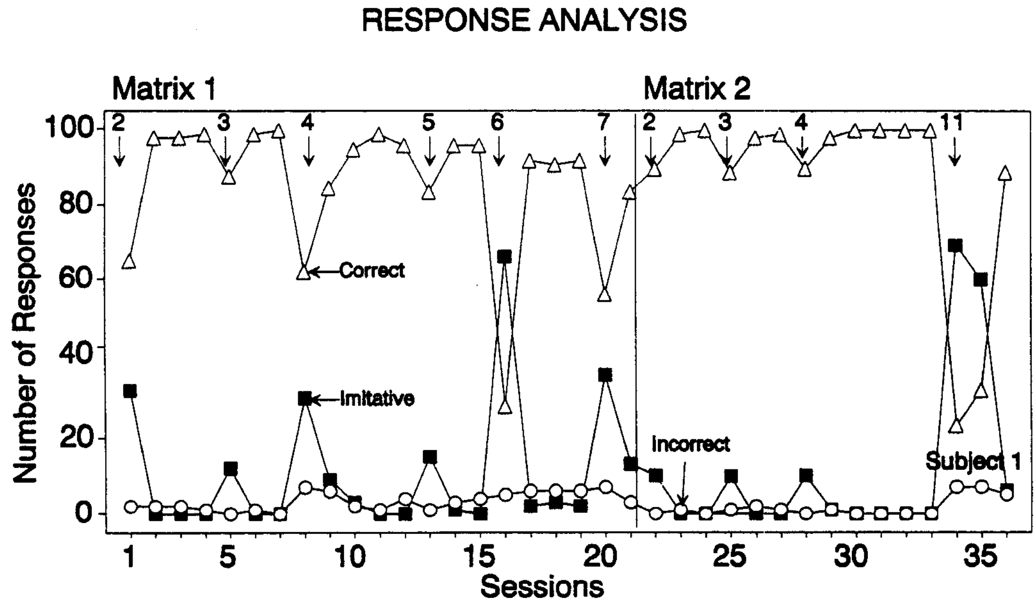

Figure 24.3. Number of correct, imitative, and incorrect responses per training session for Subject 1. Arrows indicate the number of verb-noun commands being trained across sessions.

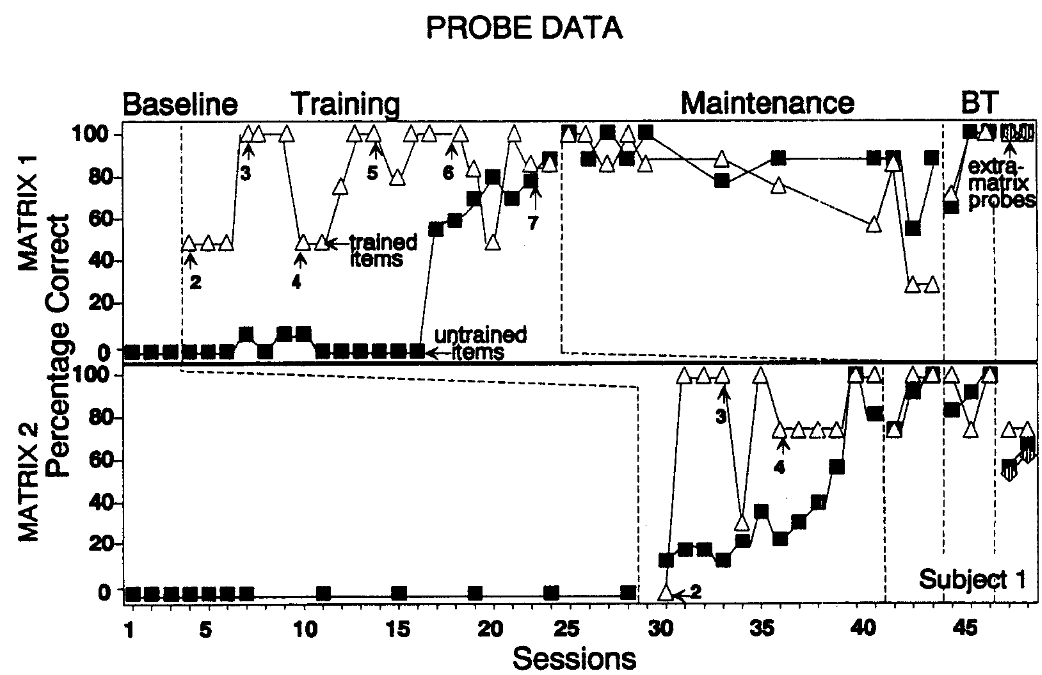

Figure 24.4. Percentage of correct trained and untrained items for Subject 1 during probe sessions. Arrows indicate the number of verb-noun commands being trained across sessions. "BT" indicates the booster training phase.

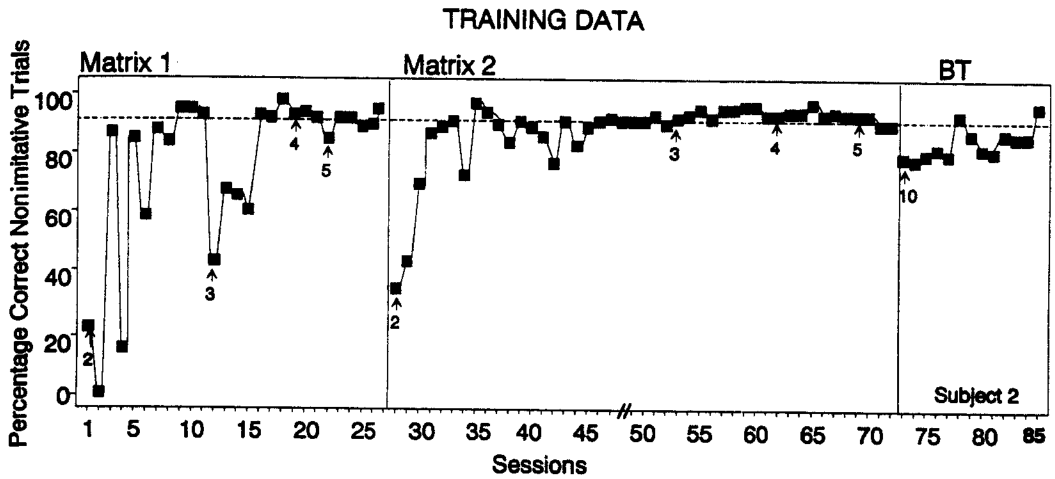

Figure 24.5. Percentage of correct nonimitative trials per training session for Subject 2. Arrows indicate the number of verb-noun commands being trained across sessions. The dotted horizontal line represents the established acquisition criterion level. "BT" indicates the booster training phase. Following training session 47 a 3-week period occurred when no treatment was administered.

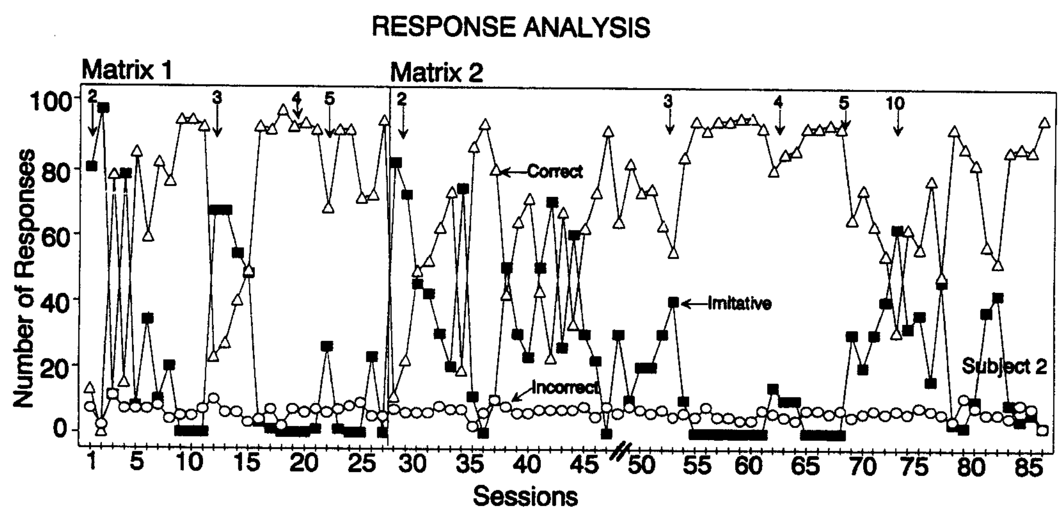

Figure 24.6. Number of correct, imitative, and incorrect responses per training session for Subject 2. Arrows indicate the number of verb-noun commands being trained across sessions. Following training session 47 a 3-week period occurred when no treatment was administered.

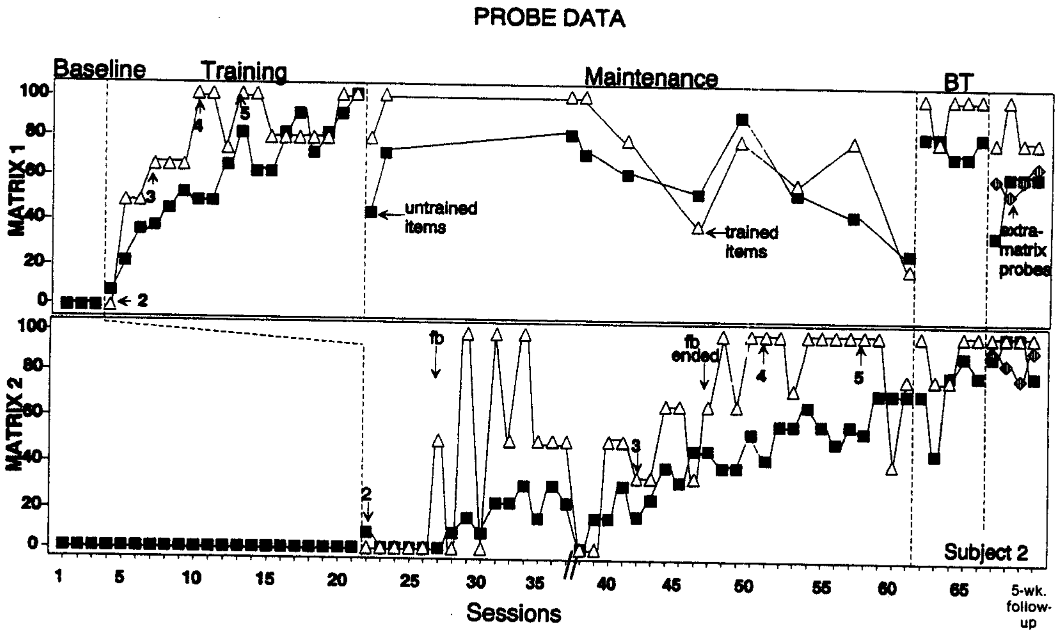

Figure 24.7. Percentage of correct trained and untrained items for Subject 2 during probe sessions. Arrows indicate the number of verb-noun commands being trained across sessions. "BT" indicates the booster training phase. "Fb" indicates response-specific feedback provided to the subject. Following training session 47 a 3-week period occurred when no probes were conducted.

and correct responses during the acquisition process. This subject required many more imitative trials to transfer stimulus control from the visual to the verbal modality. This process is most evident between training sessions 30 and 45, and between sessions 70 and 80.

Subject 2's probe data are shown in Figure 24.7. These data reveal that acquisition and generalization effects for Matrix 1 commands were rapid and robust. For Matrix 2 items, acquisition of trained commands and generalization was delayed due to overgeneralization of verbs trained in Matrix 1. Therefore, feedback regarding the accuracy of response was provided during a limited number of probe sessions. During these probes, acquisition and generalization effects became evident. However, in general, the rate of acquisition for Matrix 2 items was slow, and complete generalization within Matrix 2 was not observed until several booster training sessions were provided.

The percentage of correct nonimitative trials per session for Subject 3 are shown in Figure 24.8. These data reveal rapid acquisition of the first two commands trained. However, once a third item was entered into treatment, this subject never obtained the established acquisition criterion.

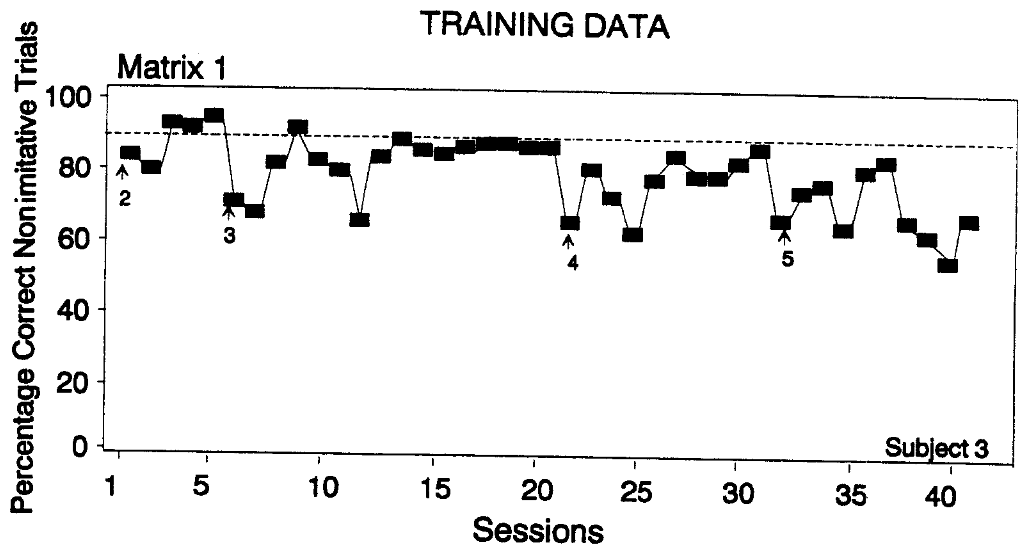

Figure 24.8. Percentage of correct nonimitative trials per training session for Subject 3. Arrows indicate the number of verb-noun commands being trained across sessions. The dotted horizontal line represents the established acquisition criterion level.

The response analysis of Subject 3's training data is shown in Figure 24.9. These data reveal that a large proportion of trials within each training session were imitative. Following session 31 the time-delay procedure was abandoned in favor of a trial-and-error procedure. Shortly thereafter the subject withdrew from the study.

Figure 24.10 shows probe data obtained on Subject 3 prior to his withdrawal from the study. Acquisition of trained items was observed following feedback regarding the accuracy of his responses. Generalization to untrained responses was not demonstrated.

Following 28 treatment sessions, Subject 4 never met the acquisition criterion on the first two training items in Matrix 1. The response analysis data revealed primarily imitative responses and probe data revealed no acquisition or generalization effects.

DISCUSSION

The purpose of this study was to evaluate the effects of a time-delay procedure on the comprehension of verb-noun commands in patients with severe auditory comprehension deficits. The selection of this procedure and its application within a matrix training paradigm was moti-

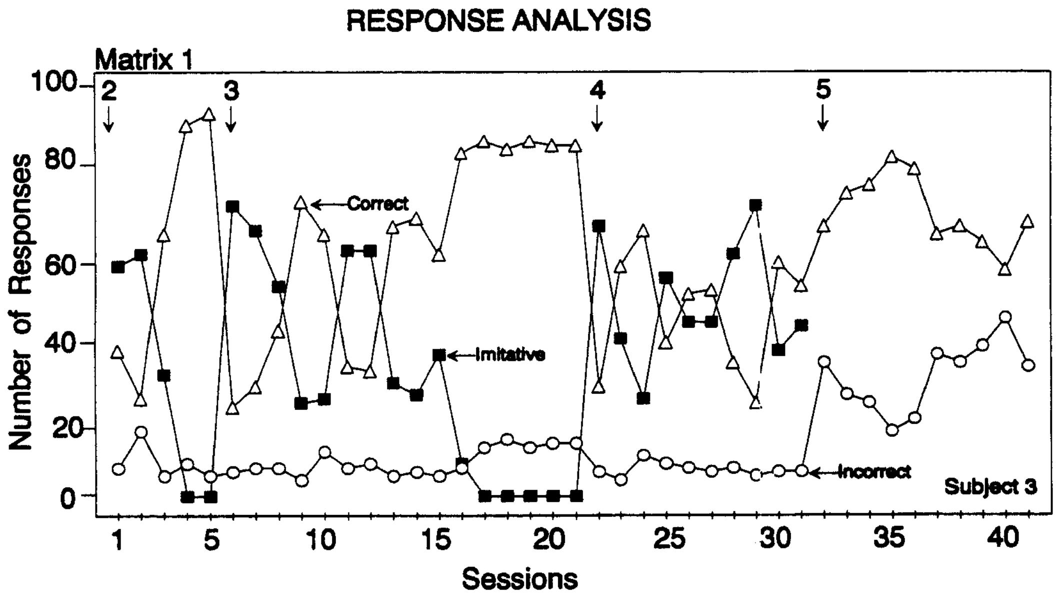

Figure 24.9. Number of correct, imitative, and incorrect responses per training session for Subject 3. Arrows indicate the number of verb-noun commands being trained across sessions.

vated by the recognition that established principles of aphasia treatment were inherent in both approaches. That is, the time-delay procedure allowed for errorless response and the presentation of stimuli through an intact modality, and principles of matrix training guided the selection and sequencing of treatment exemplars in a manner that facilitated generalized response.

For Subjects 1 and 2, the procedure proved to be both effective and efficient. Our findings indicated that Subject 1 generalized to novel verb-noun combinations following acquisition of seven and four items for Matrices 1 and 2, respectively.

Subject 2 generalized to novel verb-noun combinations following acquisition of five items from each matrix. These results are particularly impressive because one would not have expected complete intramatrix generalization until at least four verb-noun combinations had been trained within each matrix.

Previous studies examining auditory comprehension training effects in severely aphasic patients have reported negligible or limited generalization effects. For example, Holland and Sonderman (1974) trained 20 aphasic subjects to respond to token test commands using a programmed instruction technique. They reported that for their subjects, "little of what was not specifically retrained progressively and repeatedly was learned" (p. 596). These authors examined a number of variables that may have

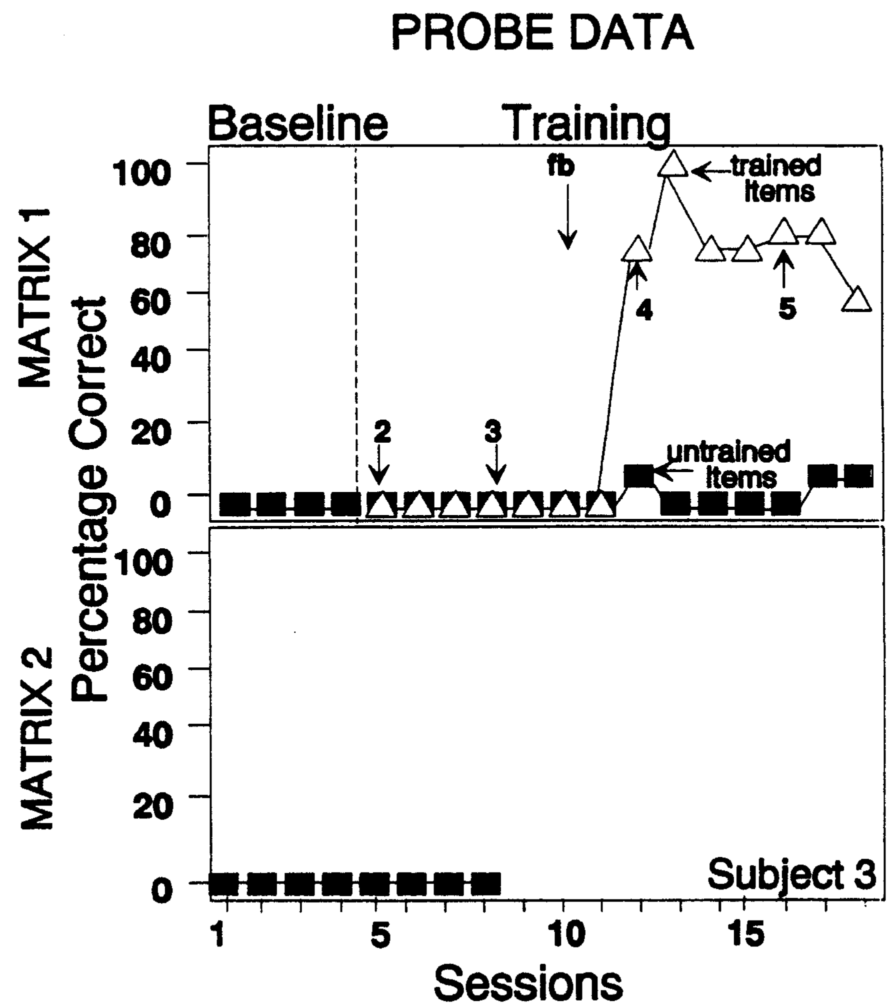

Figure 24.10. Percentage of correct trained and untrained items for Subject 3 during probe sessions. Arrows indicate the number of verb-noun commands being trained across sessions. "Fb" indicates response-specific feedback provided to the subject.

influenced their findings, including the training technique employed, severity of aphasia, frequency of therapy, and inpatient versus outpatient status. They concluded that severity of aphasia was the most accurate predictor of success in their program.

Although several methodological differences between these two studies make direct comparisons difficult, overall severity of aphasia cannot explain the findings of the current investigation. Our subjects were comparable to the "severe" subjects described by Holland and Sonderman. Further, our least impaired subject and our most impaired subject responded successfully to the treatment program.

Why Subjects 3 and 4 responded so poorly to treatment remains unclear. Subject 3 met the preestablished training criterion much as Subjects 1 and 2 did when only two items were being trained, but they required many more imitation trials as additional items were trained. Unlike Subjects 1 and 2, Subject 3 found imitation trials aversive. That is, he became increasingly frustrated as more models were provided by the trainer. Following Training Session 31, the time-delay procedure was abandoned in favor of a trial-and-error procedure in which only feedback regarding his response accuracy was delivered. His accuracy showed little improvement and more incorrect responses occurred.

Subject 4 received by far the most models of any subject, and despite his motivation to continue, he was discharged from the study following 28 sessions. He showed little progress in learning the first two training items. Other intervention procedures were applied in an attempt to overcome the learning problems. For example, a 2-second pause was inserted between the verb and the noun during the verbal presentation of training trials. However, in contrast to the findings of Liles and Brookshire (1975) and Salvatore (1976), neither of our poor responders benefited from this strategy.

Unfortunately, a post hoc analysis of subject variables including age, education, severity of aphasia, site of lesion, inpatient versus outpatient status, and measures of attention and nonverbal memory did not appear to explain the differences in outcome among our subjects. Our inability to explain individual differences and, specifically, the poor performance of Subjects 3 and 4, speaks to the need for further research. Although there appear to be boundaries to the generalizability of these procedures, differences in subject characteristics did not allow good predictions of success. Perhaps the best predictor of success in this program may be the patient's ability to discriminate between more than three verb-noun combinations during initial training sessions. This can be determined quite readily through trial therapy.

These results must be considered preliminary and additional replications will be needed before conclusions regarding the overall efficacy of these procedures can be made. However, it is encouraging that two subjects were able to learn low-probability verb-noun combinations in an essentially acontextual setting. Given that previous research has demonstrated that aphasic subjects benefit from the predictability of messages (Gardner, Albert, & Weintraub, 1975) and environmental cues (Wilcox, Davis, & Leonard, 1978), this method may prove to be valuable for training more functional instruction-following skills in patients with severe auditory comprehension impairment.

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