22. Effects of Phonologically Based Treatment on Aphasic Naming Deficits: A Model-Driven Approach

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Naming deficits accompanying aphasia have been studied extensively (Geschwind, 1967; Goodglass, 1980; Lesser, 1989) and numbers of treatments emphasizing either reactivation of the naming process or its reorganization have been advanced (Seron, 1984; Seron, Deloche, Bastard, Chassin, & Hermand, 1979; Wiegel-Crump & Koenigsknecht, 1973). In recent years, cognitive neuropsychological models of lexical processing systems have been developed (Fromkin, 1987; Morton, 1984; Newcombe & Marshall, 1984), and treatment guided by these models has been discussed. For example, the model described by Ellis and Young (1988) specifies a central semantic system interconnected by separate memory stores for phonological and graphemic word forms, or lexicons, for both input and output processes (see Figure 22.1). Intrinsic to this model is the assumption that certain modules of the naming process may be disrupted—either in isolation or in combination—and that the nature of the naming disorders that are manifested will vary depending on which aspects of the process are involved.

In keeping with this reasoning, analysis of aspects of the naming process in patients with naming deficits should lead to discovery of the disrupted components of the naming process. For example, a patient who is unable to match written or spoken words to pictures, to perform conceptual matching tasks, and to name objects graphically or orally would be likely to have a semantic system deficit. Conversely, a patient with preserved ability to match written or spoken words to pictures and to perform conceptual matching tasks, but who is unable to name orally

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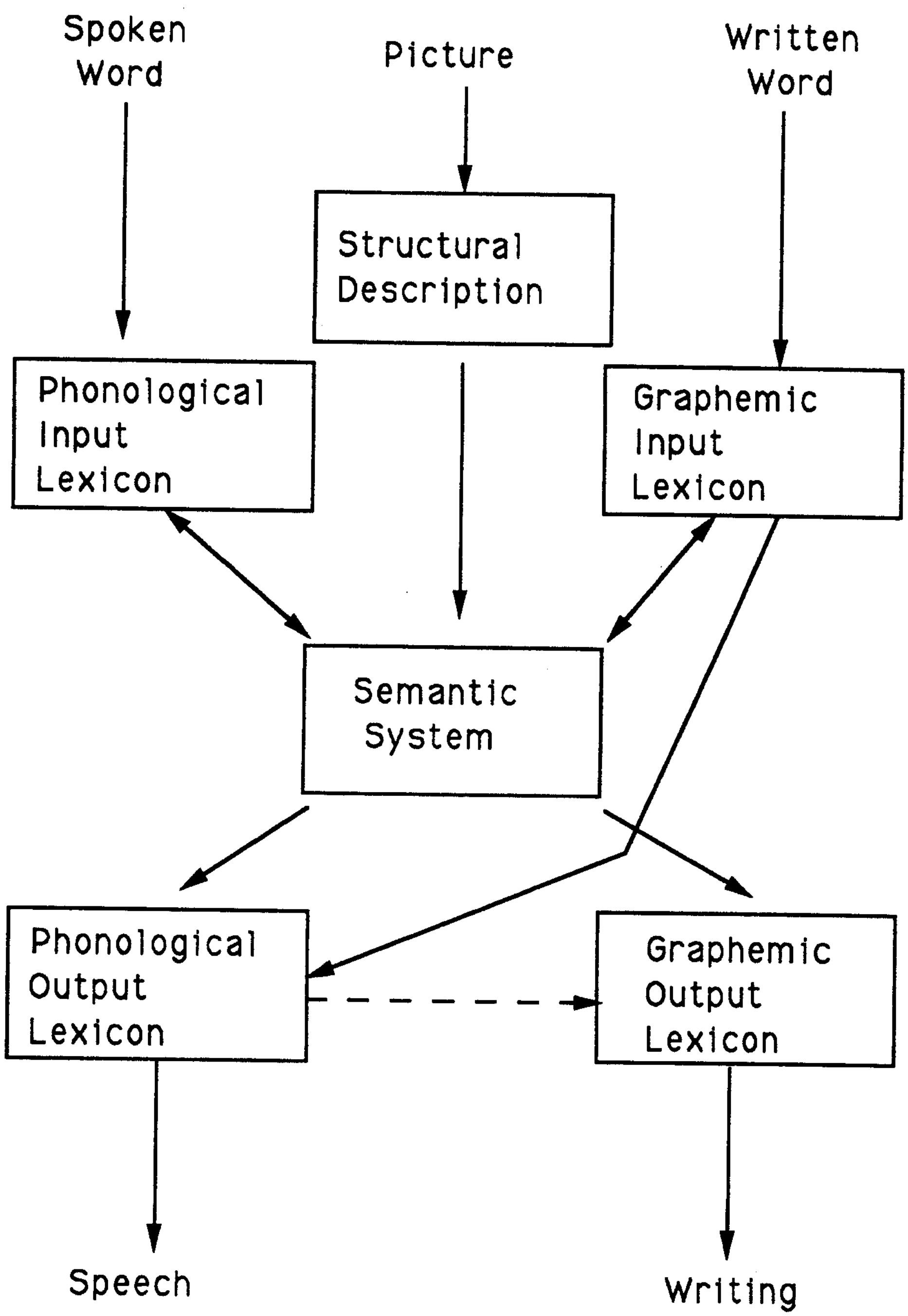

Figure 22.1. Lexical routes for recognition and production of spoken and written words (after Ellis & Young, 1988).

and/or graphically would be likely to have involvement of the phonological and/or graphemic output lexicon. Such patients' naming problems, therefore, would be accounted for by difficulty in accessing the formal lexical representation or the phonological and graphemic forms of words (Kay & Ellis, 1987; LeDorze & Nespoulous, 1989).

Model-driven treatments for naming disorders have become quite popular; their utility has been discussed by Hillis (1989a, 1989b), Holland (1989), and others as an alternative to other treatments. That is, it has been suggested that intervention focused on disrupted lexical components might serve to improve aspects of naming that rely on the disrupted components. Although this approach to intervention is intellectually appealing, particularly because of its potential for predicting response generalization patterns both within and across modalities, few studies have attempted to validate it with controlled experimental procedures.

PURPOSE

The purpose of this study was to investigate the effects of treatment on aspects of the naming process in aphasic subjects who had primary difficulty in accessing the formal lexical representations of words in attempts to name them (i.e., phonological output lexicon deficits). A phonologically based treatment was designed for this investigation. Experimental questions were:

1. Will treatment result in improved oral naming of trained nouns?
2. Will generalized oral naming to untrained semantically related and/or rhymed words occur with treatment?
3. Will cross-modal generalization to oral reading of trained items or untrained semantically related and/or rhymed words occur?
4. Will cross-modal generalization to written naming of trained or untrained semantically related and/or rhymed words result from treatment?

It was postulated that the phonologically based treatment would facilitate improved naming of trained items, and that generalized oral naming to untrained items would be expected if treatment had the effect of improving access to the phonological output lexicon. Further, it was reasoned that because, according to the model, oral naming and oral reading both require a phonological code, successful oral naming treatment might result in improved oral reading. Finally, because Ellis and Young (1988) and others have suggested a connection between the phonological and graphemic output codes, we postulated that this generalization, too, might occur.

METHOD

Subjects

Two nonfluent Broca-aphasic subjects, one male (C. G.) and one female (R. J.), both 75 years of age, participated in the study. Subjects were both right handed and monolingual English speaking. Both were high school graduates; in addition, R. J. held a college degree. Both subjects evidenced aphasia secondary to left-hemisphere, thromboembolic stroke in the distribution of the middle cerebral artery. C. G. suffered a single infarction, whereas R. J. suffered two strokes, a week apart. R. J., therefore, presented with a larger frontoparietal lesion than did C. G. The subjects were 18 and 14 months post-onset, respectively, and both presented with residual right hemiparesis.

The diagnosis of aphasia was based on results of the *Western Aphasia Battery* (Kertesz, 1982), revealing Aphasia Quotients of 33.0 and 35.8 for C. G. and R. J., respectively. The *Porch Index of Communicative Ability* (Porch, 1981) indicated overall percentiles at 41 and 32, respectively. Performance patterns on both tests revealed auditory and reading comprehension of single words superior to naming and writing. Results of the *Boston Naming Test* (Kaplan, Goodglass, & Weintraub, 1983) further indicated poor confrontation naming for both subjects, with phonemic cuing facilitating correct naming for both—more often for C. G. than for R. J. This poor naming performance stood in contrast to performance on the *Peabody Picture Vocabulary Test* (Dunn & Dunn, 1981), on which C. G. identified 83 items correctly and R. J. identified 79 correctly out of the first 100 items administered. These and other test data are shown in Table 22.1.

To further evaluate components of the naming process, a naming battery using 120 single words was administered. The battery included subtests for (a) auditory word-picture verification, (b) written word-picture verification, (c) oral naming, (d) oral reading, (e) written naming, and (f) repetition. Auditory and written word-picture verification tasks required a yes/no response following the examiner's presentation of a picture and verbal stimulus: "Is this a ______?" Both phonemic ($n = 15$) and semantically related ($n = 30$) foils were included. The results, shown in Table 22.2, indicated few auditory or written word recognition errors, but many oral naming, oral reading, and written naming errors for both

TABLE 22.1. TEST DATA FOR SUBJECT 1 (C. G.) AND SUBJECT 2 (R. J.)

	C. G.	*R. J.*
Western Aphasia Battery		
Aphasia Quotient	33.0	35.8
Spontaneous Speech	7.0	7.0
Comprehension	6.7	5.3
Yes/No Questions	57/60	45/60
Auditory Word Recognition	52/60	45/60
Sequential Commands	24/80	16/80
Repetition	0.6	1.4
Naming	2.2	4.2
Object Naming	12/60	26/60
Word Fluency	2/60	0/60
Sentence Completion	6/10	10/10
Responsive Speech	2/10	6/10
Reading	5.9	5.6
Written Word–Object	6/6	6/6
Written Word–Picture	6/6	6/6
Picture–Written Word	6/6	4/6
Writing	3.6	1.3
Porch Index of Communicative Ability		
Overall Percentile	41	32
Writing	33	27
Subtest B	5.1	5.0
Copying	72	15
Reading	58	31
Subtest VII	12.0	13.2
Pantomime	79	38
Verbal	28	33
Subtest IV	6.8	6.1
Auditory	47	36
Subtest X	13.9	13.0
Visual	35	35
Boston Naming Test	4/60	8/60
Peabody Picture Vocabulary Test	83/100	79/100

TABLE 22.2. NAMING BATTERY ERRORS FOR SUBJECT 1 (C. G.) AND SUBJECT 2 (R. J.)

	C. G.						*R. J.*					
	TOTAL		SEMANTIC		PHONEMIC		TOTAL		SEMANTIC		PHONEMIC	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Auditory word-picture verification	8/120	(6.6)	5/30	(16)	2/15	(13)	26/120	(21.6)	15/30	(50)	5/15	(32)
Written word-picture verification	15/120	(4)	3/30	(1)	2/15	(13)	105/120	(12.5)	13/30	(43)	0/15	(0)
Oral naming	105/120	(87)	21/105	(20)	9/105	(8.6)	106/120	(88)	11/106	(10)	15/106	(14)
Oral reading	92/120	(76)	22/92	(23)	16/92	(17)	66/120	(55)	23/66	(34)	15/66	(22)
Written naming	96/120	(80)	11/96	(11)	5/96	(5)	120/120	(100)	—		—	
Repetition	76/120	(63)	6/76	(7.8)	28/76	(36)	25/120	(20)	1/25	(4)	12/25	(60)

subjects. Noteworthy differences in performance across subjects included the following:

1. C. G. evidenced more severe involvement (82% errors) in oral reading than did R. J. (47% errors).
2. R. J. evidenced 100% errors in written naming (i.e., she could not write even single letters), whereas C. G. evidenced 80% errors in written naming, but wrote the remaining 20% of the words correctly.

These findings, coupled with other test data, the semantic and phonemic errors made by both subjects in oral naming and oral reading, and the observation that phonemic cuing served to facilitate naming of at least some words for both subjects, indicated breakdowns across subjects in phonological word form selection. In addition, written naming deficits exhibited by both subjects indicated deficits in the graphemic output lexicon.

Experimental Stimuli

Two sets of 30 4×5-inch, black-and-white line drawings of monosyllabic nouns, matched for written frequency of occurrence in the English language (Francis & Kucera, 1982) were used. For each of the 60 pictured items, a 4×5-inch written (word) stimulus card was used for oral reading probes. Each word set included (a) 10 target/training items (e.g., *house*), (b) 10 items rhyming with target items (e.g., *mouse*), and (c) 10 items semantically related to the target items (e.g., *door*). Items included in each set are listed in Appendix 22.A.

Design

A single-subject, multiple-baseline design across behaviors and subjects was used (McReynolds & Kearns, 1983). Oral naming of target items from each set of nouns was consecutively trained, whereas semantically related and rhymed words from both sets were untrained and remained in baseline conditions throughout the study.

Baseline. During the baseline phase, oral naming, written naming, and oral reading of the 60 items were assessed by random presentation of a picture or word stimulus. All responses were coded using 5-point, multidimensional scoring protocols designed to describe the semantic and phonological/graphemic nature of responses (see Appendixes 22.B and

22.C). Responses given a score of 4 or 5 were considered correct for the purpose of data analysis.

Treatment. A phonologically based treatment (after Howard, Patterson, Franklin, Orchard-Lisle, & Morton, 1985) was used to train oral naming of target words from Sets 1 and 2. The order of training was counterbalanced across subjects to control for order effects and all treatment sessions were videotaped. On each training trial, a picture stimulus was presented for the subject to name. When a correct response (score of 5) was not produced within a 10-second response interval, a rhymed cue was given. For example, if the target was *bat,* the cue "It sounds like *mat;* it's a ______" was provided. If this cue did not result in a correct response, a phonemic cue was provided and was followed by a model for the subject to repeat when necessary. When a correct response occurred at any level of cuing, the subject was required to repeat the response three times and to name the item once again following a 5-second delay. A new trial then was begun with a new picture stimulus from the training set. At least 20 training trials per session were provided. Training for each set was continued until an 80% criterion level on two out of three probe sessions was achieved or until a maximum of 15 training sessions had been completed.

Generalization Probes. Probes were administered at the beginning of each treatment session using procedures identical to baseline. Shifts in base-rate performance of 30% or greater on untrained items during oral naming training was considered evidence of generalization. Data collected during baseline and generalization probing served as the dependent variable throughout the study.

Interobserver Reliability. Reliability on the dependent variable was obtained by the examiner and an independent observer, who were situated behind a one-way mirror, scoring on-line all responses produced during baseline and probe sessions using the multidimensional scoring protocols. Point-to-point agreement ranged from 88% to 97%, with a mean of 92% across all samples.

Procedural reliability also was obtained from a randomly selected 30% of videorecorded treatment sessions. An independent observer coded aspects of the treatment including the accuracy of cues and feedback provided. Point-to-point agreement between the observer and the established treatment protocol ranged from 90% to 100%, with a mean of 98%.

RESULTS

Results of the study are depicted graphically in Figures 22.2–22.5 for C. G. and in Figures 22.6–22.9 for R. J.

Subject 1: C. G.

Oral Naming—Acquisition of Trained Items. Oral naming of target items across baseline, treatment, maintenance, and follow-up phases of the study for C. G. are shown in Figure 22.2. During baseline, the percentage of correct production of both Set 1 and Set 2 items was stable with correct response ranging from 0% to 30%. When treatment was applied to Set 2 (trained first and shown in the top graph in Figure 22.2), naming of target items improved, reaching a high of 70% correct. Similarly, during Set 1 training (trained following Set 2 and shown in the bottom graph in Figure 22.1), naming of target items improved to a high of 80% correct. These data indicated a clear intervention effect, but criterion-level response was not reached for either training set. Additional analysis of error patterns noted throughout the study, however, indicated increased phonemic errors occurring during final treatment sessions (29%) as compared to baseline, where unrelated and semantic errors prevailed relative to phonemic errors (8%).

Generalized Oral Naming. Response generalization data for oral naming are depicted in Figure 22.3. These data indicate that generalization occurred to untrained items that rhymed with and were semantically related to Set 2 during Set 2 training; however, no response generalization to either rhymed or semantically related items was noted during Set 1 training.

Generalized Oral Reading. Generalized oral reading occurring during oral naming treatment for C. G. is shown in Figure 22.4. As indicated, oral reading of both trained and untrained items improved. That is, oral reading of target items on both Set 2 and Set 1 improved during naming training of Set 2. Oral reading of Set 2 items reached a 90% correct level, whereas oral reading of Set 1 items reached an 80% level. Generalized oral reading of Set 2 rhyme-related and semantically related items also was noted during this training with response reaching a 70% level for rhymed words and a 60% level for semantically related words. Similarly, when oral naming of Set 1 was trained, further generalization to some rhymed and semantically related items was noted. Increased phonemic errors in oral reading also were seen throughout naming treatment. During baseline, 17% of errors were phonemic, whereas, at the completion of treatment, 30% were considered phonemic.

Generalized Written Naming. Generalized written naming (see Figure 22.5) was limited to target Set 2 items during Set 2 oral naming treatment with a shift from base-rate, 20% correct, to 50% correct during this train-

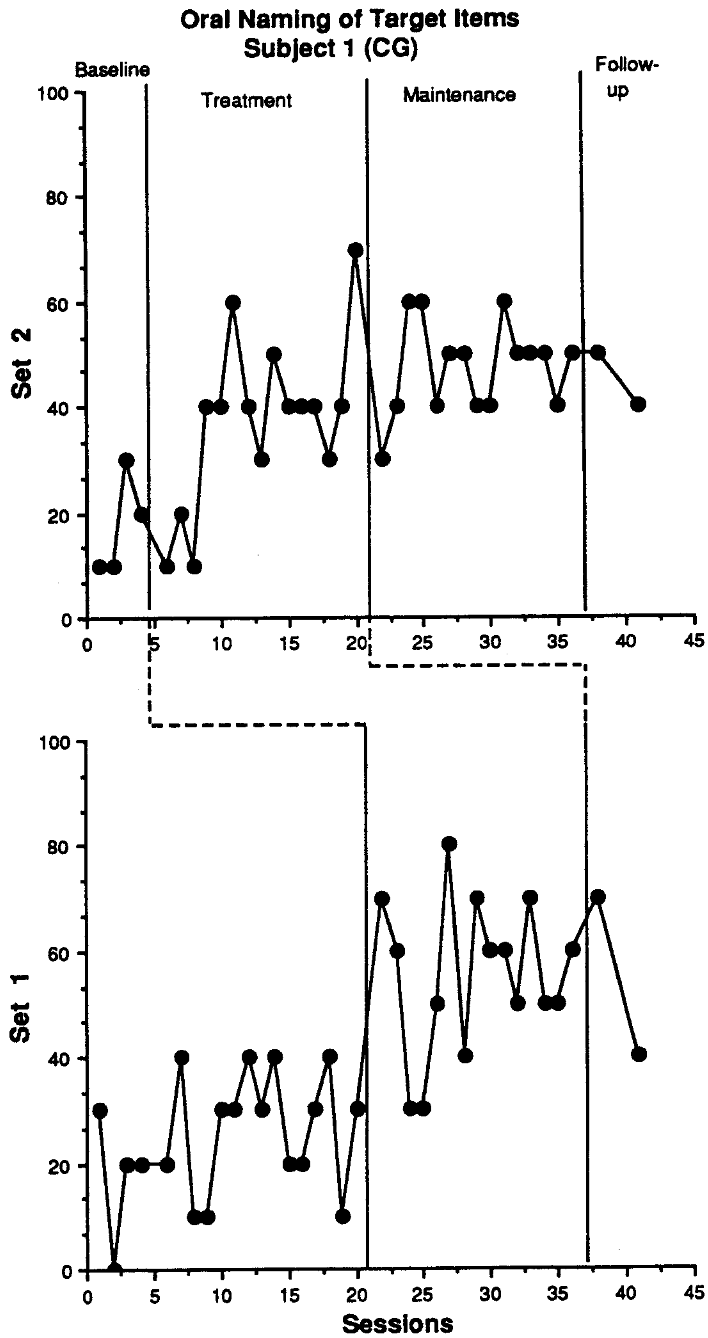

Figure 22.2. Percentage of correct oral naming of target/trained items across all phases of the study for Subject 1 (C. G.).

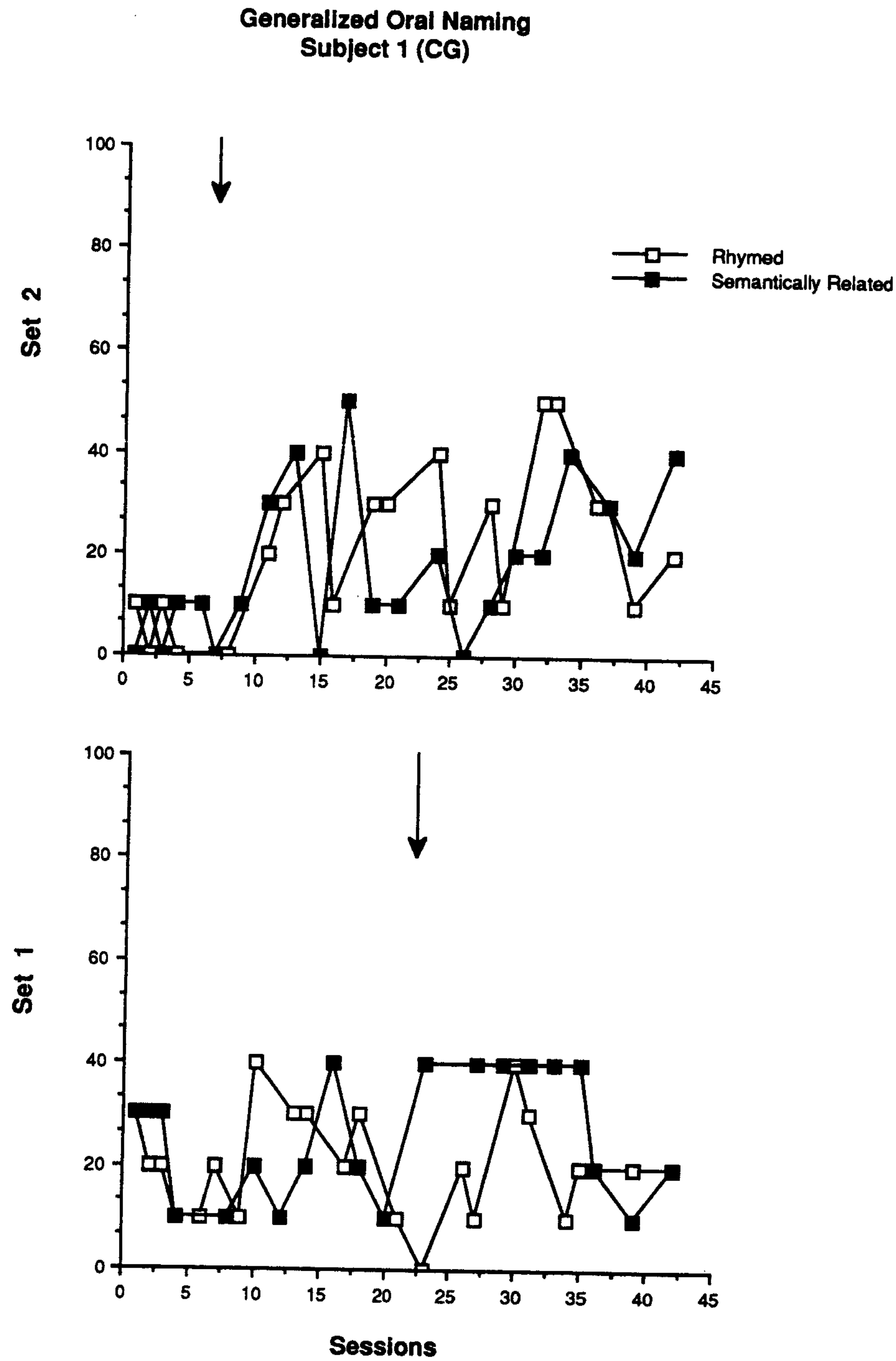

Figure 22.3. Percentage of correct oral naming of untrained words rhyming with and semantically related to target words for Subject 1. Arrows indicate sessions in which treatment of target items on each set was begun.

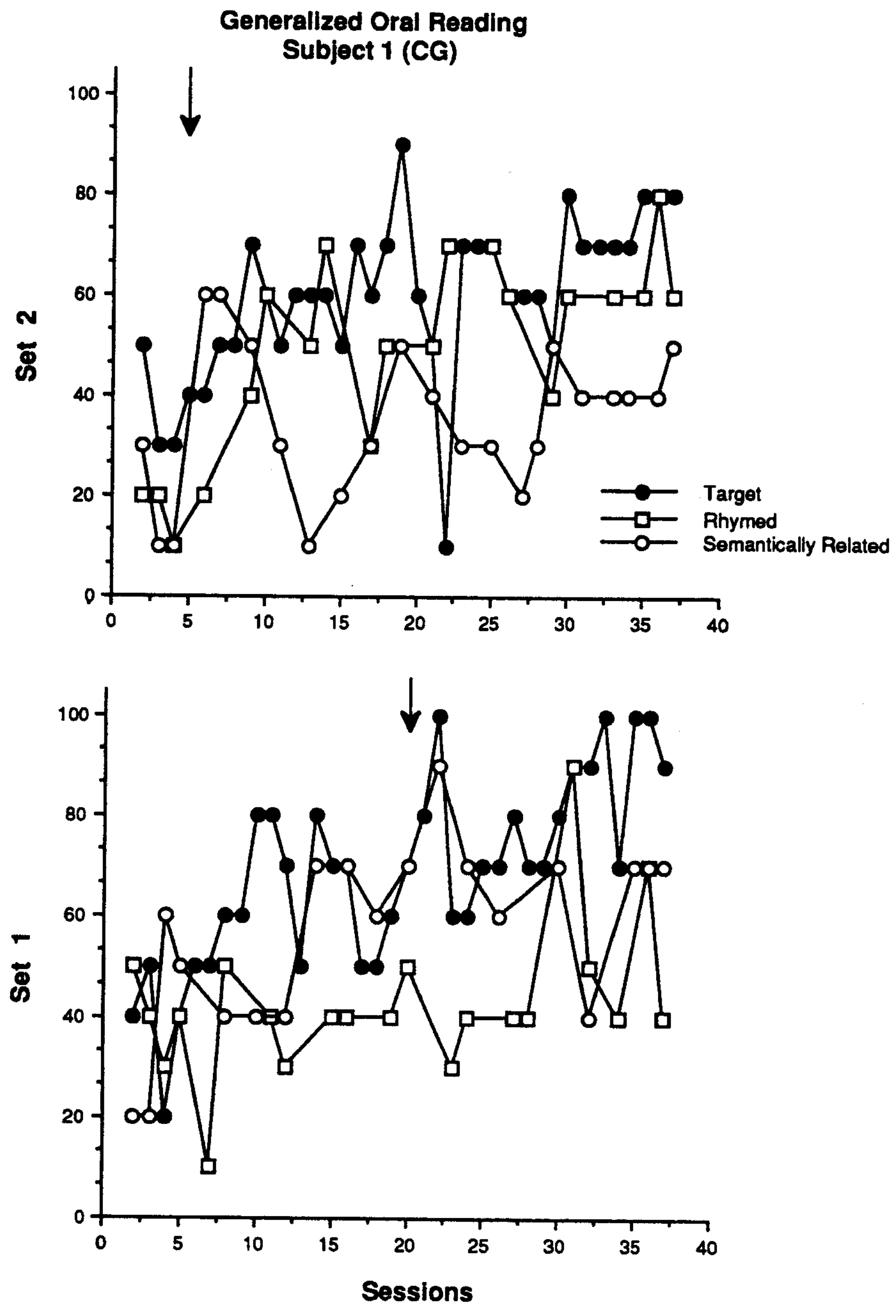

Figure 22.4. Percentage of correct oral reading during oral naming treatment for Subject 1. Arrows indicate sessions in which oral naming treatment of target items on each set was begun.

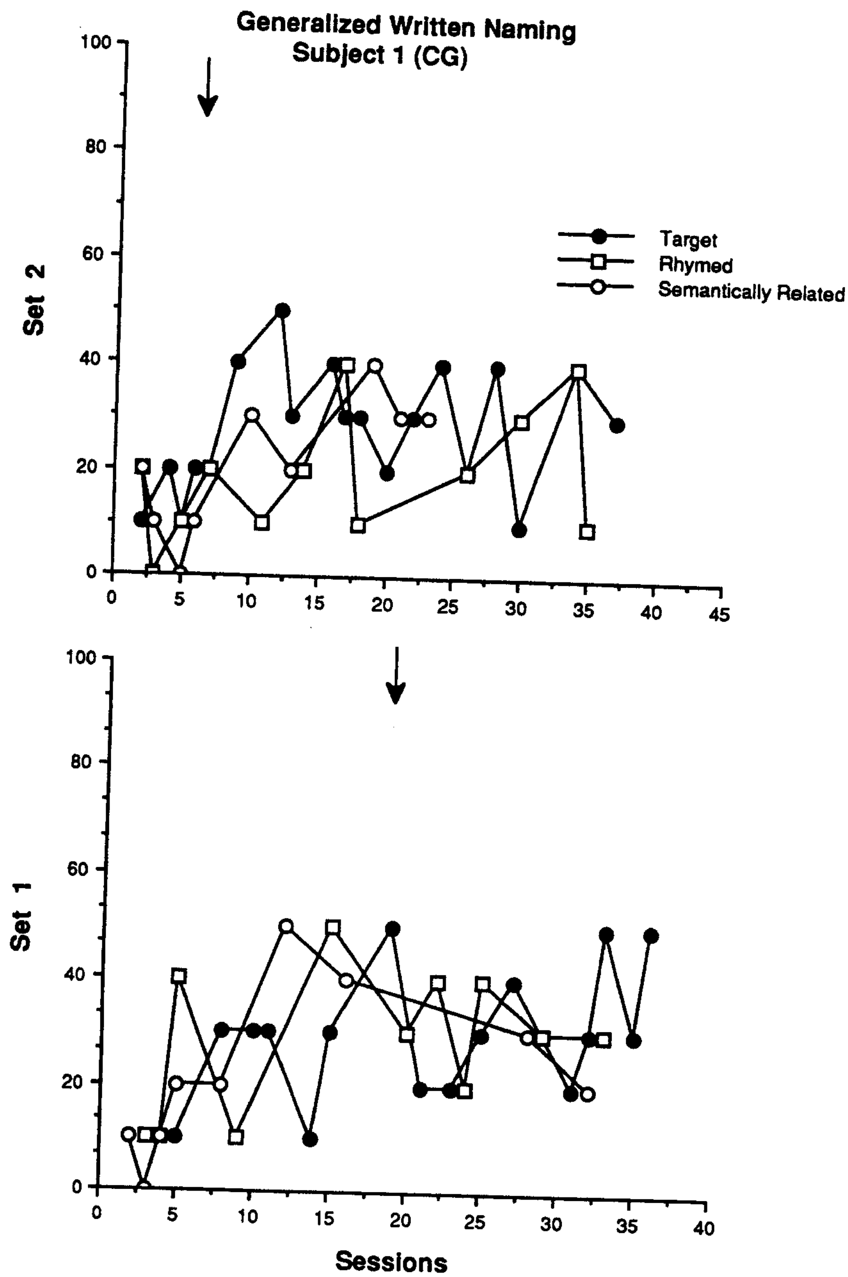

Figure 22.5. Percentage of correct written naming during oral naming treatment for Subject 1. Arrows indicate sessions in which oral naming treatment of target items on each set was begun.

ing. Changes in C. G.'s writing patterns were noted throughout treatment on target, rhyme-related, and semantically related items on both sets. That is, written responses occurring during oral naming treatment, although erroneous, more closely approximated their targets with spelling errors replacing baseline semantic and unrecognizable responses.

Subject 2: R. J.

Oral Naming—Acquisition of Trained Items. Findings similar to those noted for C. G. with regard to oral naming were noted for R. J. (see Figure 22.6). Following stable baselines during which naming of trained items ranged from 0% to 20% correct for Set 1 and 0% to 40% correct for Set 2, naming improved, ranging from 20% to 60% correct and from 40% to 70% correct for Sets 1 and 2, respectively. These data indicated a clear acquisition effect, and levels of response achieved during training were maintained when treatment was discontinued. However, criterion response was not reached within the maximum 15 training sessions for either set of naming responses.

Generalized Oral Naming. Generalization to rhymed and semantically related items, shown in Figure 22.7, exceeded levels noted for C. G. As each set was trained, improved naming of corresponding generalization items was noted. During Set 1 training, naming of untrained rhymed words improved from 30% correct during baseline to 60% correct, whereas naming of untrained semantically related items improved from 20% to 80% correct. When Set 2 was trained, corresponding rhymed items improved from 40% to 70% correct and semantically related items improved from 30% to 60% correct.

Generalized Oral Reading. Generalization to oral reading also was noted for R. J. (see Figure 22.8). However, R. J. read many of the stimulus words correctly during baseline, which therefore limited opportunity for observing generalization.

Generalized Written Naming. With regard to written naming for R. J., results contrasting those noted for C. G. were seen (see Figure 22.9). That is, no generalization to written naming was noted despite the high levels of oral naming achieved for both trained and untrained items during oral naming training.

SUMMARY AND CONCLUSIONS

The results of this study indicated that phonologically based treatment resulted in improved oral naming in both aphasic subjects with phonological output lexicon deficits. Other treatments for naming such as various cuing hierarchies (Thompson & Kearns, 1981), nonspecific stimulation treatment (Wiegel-Crump & Koenigsknecht, 1973), and semantically based treatment (Howard et al., 1985) also have facilitated improved naming.

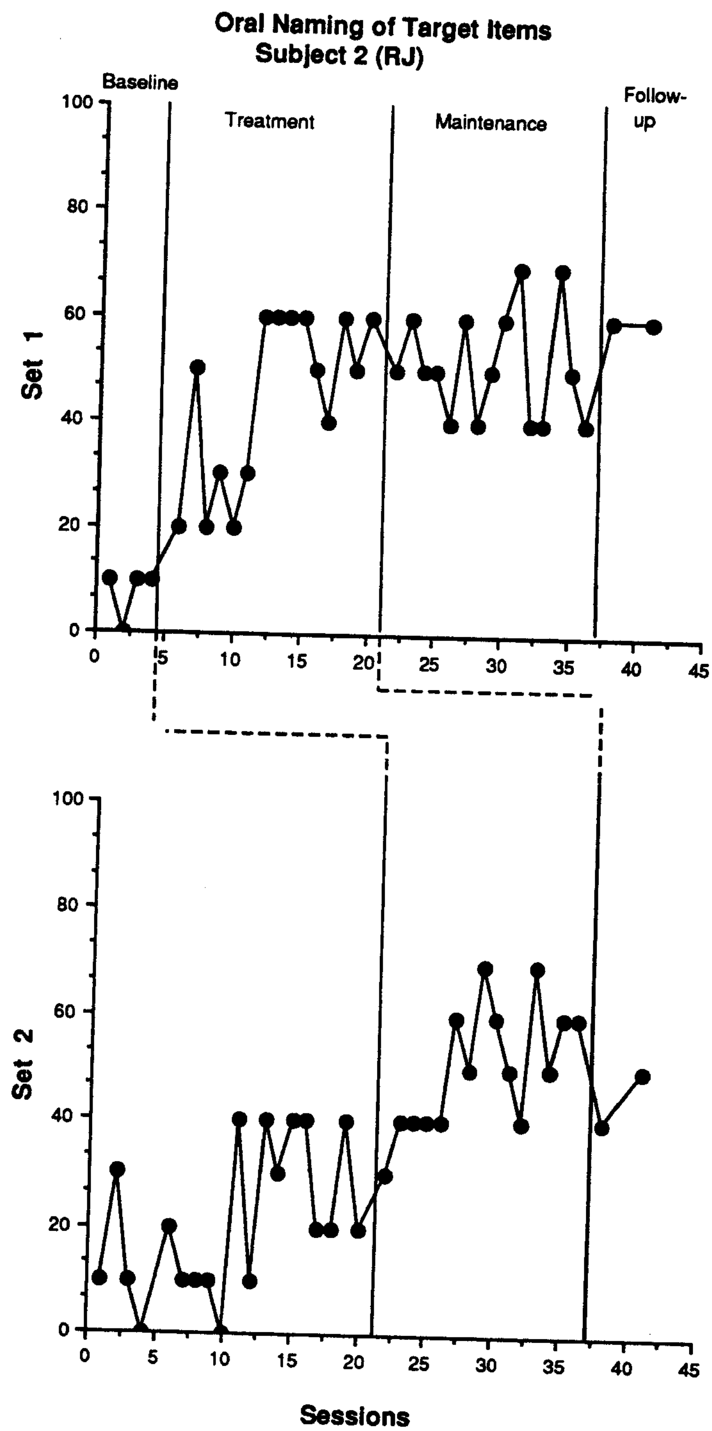

Figure 22.6. Percentage of correct oral naming of target/trained items across all phases of the study for Subject 2 (R. J.).

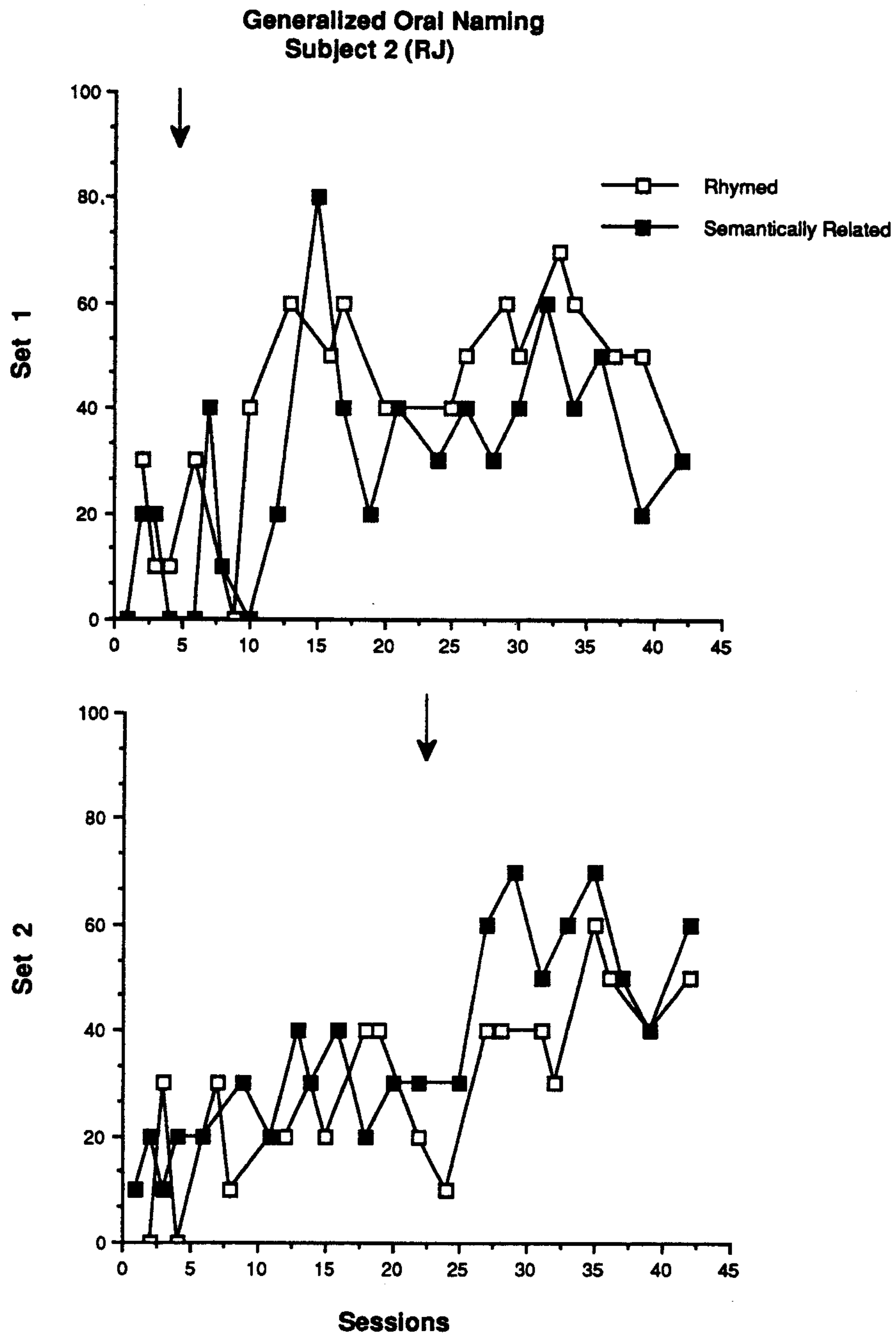

Figure 22.7. Percentage of correct oral naming of untrained words rhyming with and semantically related to target words for Subject 2. Arrows indicate sessions in which treatment of target items on each set was begun.

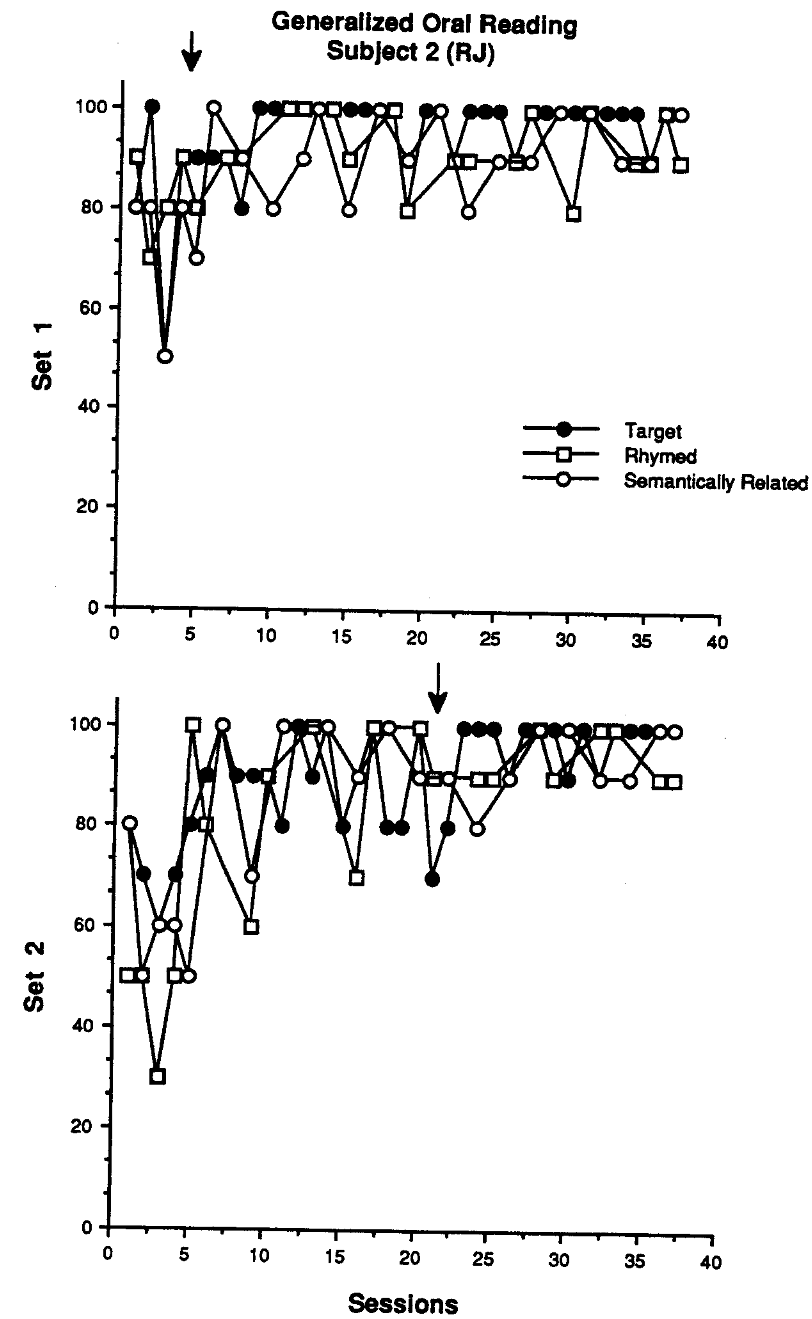

Figure 22.8. Percentage of correct oral reading during oral naming treatment for Subject 2. Arrows indicate sessions in which oral naming treatment of target items on each set was begun.

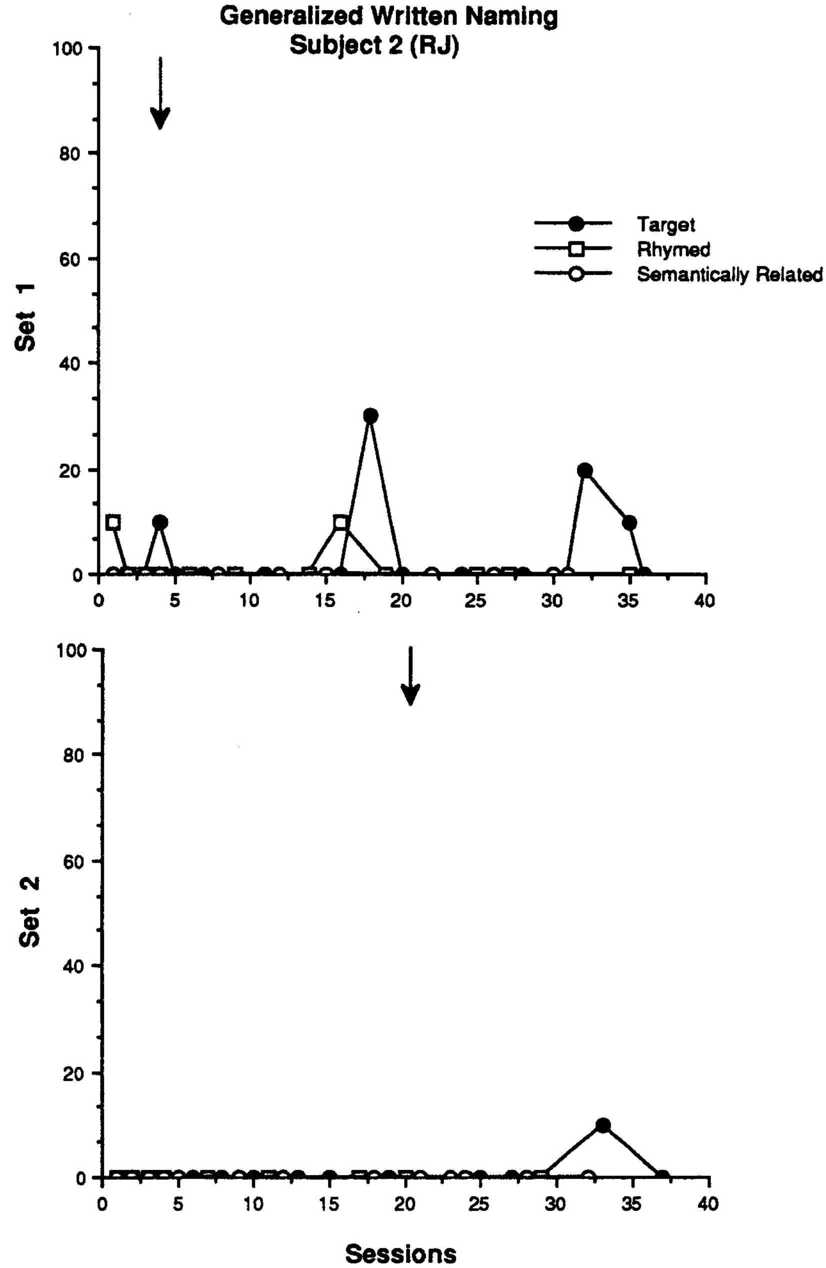

Figure 22.9. Percentage of correct written naming during oral naming treatment for Subject 2. Arrows indicate sessions in which oral naming treatment of target items on each set was begun.

The present findings depart somewhat from those of other studies (e.g., Thompson & Kearns, 1981) in terms of generalization. That is, treatment resulted in generalized naming of untrained words for both subjects, indicating that access to the phonological form of words via the semantic system was improved. Of interest was the observed difference in generalization patterns across the two subjects, with R. J. showing more generalized naming than C. G. One possible explanation for this difference concerns R. J.'s oral reading ability, which was superior to C. G.'s. According to the Ellis and Young (1988) model, oral reading and oral naming both use the phonological output lexicon. Apparently, before treatment was applied R. J. had access by some route to the phonological output lexicon, allowing her to accomplish oral reading (see Figure 22.1), but had difficulty accessing it through the semantic system. Naming treatment, which facilitated this access, resulted in generalized oral naming. Patients such as C. G., with more marked involvement of the phonological output lexicon evidenced by equally impaired oral naming and oral reading, may be more resistant to generalization.

Increases in phonemic errors noted on both trained and untrained oral naming items for C. G. suggest, however, that improved access to the phonological form of words through the semantic system also was improved, but was incomplete, for this subject, even though measured generalization levels were not high. In early phases of the experiment, C. G.'s naming attempts often resulted in semantic paraphasias. At the end of the experiment, semantic paraphasias were less evident and were replaced by phonemic paraphasias. These observations, in keeping with ideas generated by Caramazza and Hillis (unpublished manuscript), suggest that in initial attempts to name, instead of accessing the appropriate phonological representation for target words, lexical-semantic entries in the lexicon related to the target were accessed, resulting in semantic paraphasias. When access to phonological representations was improved through naming training, a resulting decrease in semantic errors was seen, with a concomitant increase in phonemic errors.

Findings from this study also indicated cross-modal generalization from naming to oral reading; in both cases, oral reading levels exceeded oral naming levels. Again, because both tasks apparently use the phonological output lexicon, improving access to the phonological form of words via the semantic system in oral naming may have strengthened access to the phonological code in oral reading. It is likely that superior oral reading as compared to oral naming was accomplished by the subjects' bypassing the semantic system, using an alternate reading route (see Figure 22.1).

Cross-modal generalization from oral naming to written naming was inconsistent across subjects in this study. This finding may be explained by the extent of the subjects' preexperimental involvement of the graphemic output lexicon. C. G., our subject with some, although minimal, residual writing ability, improved in writing; however, R. J., our patient with apparently no memory store for the graphemic form of words, did not improve.

In conclusion, findings from this study are provocative. Although response generalization patterns were not overwhelming, the observed generalization exceeded that seen in other naming studies (e.g., Howard et al., 1985; Thompson & Kearns, 1981). Differences across studies, however, could be accounted for in a number of ways. The treatment method used in the present study, which focused on the component of lexical processing determined to be impaired in our subjects, might have influenced observed generalization patterns. Or perhaps (and highly likely) the nature of the deficit in our subjects differed from that in subjects who were previously studied. Certainly, the extent to which response generalization was measured departed from that in other studies of naming treatment with aphasic subjects (with the exception of Hillis, 1989b), in that generalization was measured within and across theoretically interrelated modalities. Perhaps similar generalization patterns would have been noted in previous studies if additional aspects of the naming process had been examined.

Findings from this study need to be replicated in additional aphasic subjects; in addition, studies examining the relative effectiveness of various treatments for naming must be conducted before statements regarding the superiority of model-driven treatments are made. Further, functional relationships between components of the naming process and changes in error patterns seen during treatment across modalities are in need of continued careful examination. The present data suggest that future examination of naming intervention guided by information-processing models may be a fruitful undertaking. Not only might this endeavor lead to effective treatment strategies for patients with naming disorders, but it might also provide data to validate and/or revise existing models of naming.

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APPENDIX 22.A
EXPERIMENTAL STIMULI

Trained Target	*Untrained Rhyming Word*	*Untrained Semantically Related Word*
Set 1		
star	car	sun
fish	dish	shell
pear	bear	grape
coat	boat	pants
log	dog	fire
bat	cat	ball
peas	cheese	corn
pin	fin	tacks
socks	box	shoes
house	mouse	door
Set 2		
lip	ship	teeth
wrench	bench	drill
nose	rose	face
hook	book	pole
spoon	moon	knife
heel	seal	toes
farm	arm	pig
bug	rug	snake
lock	clock	keys
soap	rope	sink

APPENDIX 22.B
MULTIDIMENSIONAL SCORING: ORAL NAMING AND ORAL READING

Score	*Response Definition*
5	Correct, complete; distorted articulation or prosody; delayed; or self-corrected within 10-second response interval
4	Substitution or addition of one phoneme
3	Related word/semantic paraphasia or identifiable error word phonemically different from the target by at least two phonemes
2	At least one recognizable phoneme of the target response
1	Unintelligible, perseverative, or no response

APPENDIX 22.C
MULTIDIMENSIONAL SCORING: WRITTEN NAMING

Score	*Response Definition*
5	Correct, complete; distorted, delayed, or self-corrected within 10-second response interval
4	Addition or deletion of one grapheme
3	Related word/semantic paraphasia or identifiable error word with graphemes differing from the target by at least 2
2	One correct recognizable grapheme
1	Unintelligible, perseverative, or no response