CHAPTER

24

Effects of Separate Treatments for Distinct Impairments Within the Naming Process

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A recent trend in clinical management of aphasia has been the development of model-based treatment/intervention guided by a model of the language process to be treated, together with evidence for specifying a particular patient's level of breakdown in that process (Behrmann, 1987; Behrmann and Herdan, 1987; Byng and Coltheart, 1986; Code and Muller, 1983; Howard and Hatfield, 1987; Hillis and Caramazza, 1987). It must be recognized, however, that the available models of the cognitive processes that underlie specific language tasks do not themselves provide direction regarding which components are subject to remediation or by which procedures (Caramazza, 1989). At best, model-driven analysis of a patient's performance of a particular complex language task, such as naming or reading, facilitates identification of those components of the process that need to be modified or circumvented for the patient to produce a correct response. It is the purpose of the present study to illustrate how such analysis of a patient's performance, directed toward specifying the level or levels of damage within a model of a particular language process, can provide a framework for deciding precisely what it is that should be treated. A secondary aim is to show that measuring the effects of a given intervention on various tasks that require the targeted component of the treated language process can sometimes yield evidence for proposing that the specific processing component was affected by the applied technique(s).

A chronically aphasic patient is described whose pattern of errors in various tasks indicates two levels of disruption in the naming process: the semantic system and the output system for retrieving the phonologic representation (stored sound) of the word. Results from a multiple-baseline study demonstrate that separate interventions specifically affected these targeted levels. Whether or not this information can be helpful in identifying other patients who are good candidates for the interventions found to be efficacious for a single subject remains a question. The results reported merely allow conjectures regarding the types of naming disorders in other patients that might respond to each strategy. Perhaps studying a series of patients with each hypothesized locus of impairment, subjected to the identical treatment procedures, would provide support for these speculations, if differences between individuals who show variant patterns of responsiveness to the interventions are carefully identified and reported. However, at this point, the specific procedures described here are probably not important at all. That is, the effectiveness of the treatment methods may be a trivial point with respect to treating any other patients, although, of course, the effects were not trivial to this patient, since they allowed her to achieve success in a variety of daily situations, including competitive employment. More important, the general method illustrated, of gearing treatment toward clearly specified deficits within the complex process of naming, can be a useful approach to treating other patients.

CASE HISTORY

HG, a 22-year-old, right-handed woman, suffered multiple cerebral contusions at age 15. A recent magnetic resonance imaging scan revealed a large area of damage in the left temporal-parietal region and smaller areas in the left frontal and right temporal lobes. At 7 years after onset, when this study began, HG's verbal output was limited to low-volume, extended English jargon. Her agrammatic writing revealed frequent semantic and spelling errors, but she spontaneously spelled many words that she failed to produce verbally. *No* accurate verbal names were elicited with cues. There were no noted cranial nerve deficits. Auditory and reading comprehension were severely impaired; she scored 11 of 36 on both auditory and printed versions of the Modified Token Test (De Renzi and Faglioni, 1987).

PART 1: IDENTIFICATION OF LEVELS OF BREAKDOWN IN THE NAMING PROCESS

BASIS OF DISPROPORTIONATE VERBAL ERRORS

HG's initially profound oral naming impairment could not be attributed only to input or semantic processes, since written naming of the same items was often accurate. Her fluent, well-articulated speech contraindicated motor speech deficits. To test the hypothesis that HG was unable to access the phonologic representations of words from long-term storage — the *phonologic output lexicon* in information processing models of the lexical system (Caramazza, 1986) — a reading battery was administered. If impaired verbal naming resulted from damage at the level of the phonologic output lexicon, the subject also should be unable to read aloud by addressing phonologic representations but might read by applying grapheme-to-phoneme correspondence rules.

The battery included lists of 68 pronounceable nonwords and 326 words, controlled for various lexical and orthographic parameters. With minimal prompting, HG haltingly "sounded out" each item. She read regular words more accurately than irregular words [29 versus 7% correct, respectively; chi-square = 6.16 (df = 2) (Ed. Sci. Statistics, 1981); $p < .05$] and read nonwords (e.g., hannee → /hæni/) more accurately than words [94 versus 27%, respectively; chi-square = 65.68 (df = 2); $p < .01$]. Nearly all her errors on words indicated application of legal grapheme-to-phoneme conversion rules (e.g., though → /θof/). These consistent errors do not seem to reflect motor programming deficits, but support the hypothesis that HG consistently assembles a plausible pronunciation, in lieu of access to the stored, phonologic representation of the word. After practice reading in this fashion, HG made similar errors in other tasks. For example, in naming, a pictured light elicited [lαIft], and in spontaneous speech, she often mentioned a [ʤoʊb] (job). Apparently, HG retrieved an orthographic representation and assembled a recognizable verbal rendition by converting the internal series of graphemes to a phoneme sequence.

BASIS OF SEMANTIC ERRORS

When HG began to produce recognizable verbal names, by means of the assembly procedure described above, many semantic paraphasias were revealed (e.g., a pictured lion elicited [tIgǝ˞]). To identify the source of semantic errors, names of 144 objects were presented for oral and written naming, oral reading, dictation, repetition, and auditory and printed word picture matching in counterbalanced blocks over seven sessions. HG produced comparable types and rates of errors in response to the same items across all tasks, except in oral reading, which she accomplished by grapheme-to-phoneme conversion (Table 24-1). Her most frequent errors were semantic errors (e.g., shirt → "pants"). Notably, the identical error response often occurred across input and output modalities. There were no statistically significant differences between tasks for total errors (chi-square = 5.00; $p = .42$) or semantic errors (chi-square = 0.98; $p = .96$). Furthermore, Pearson product-moment correlations between each pair of tasks, excluding the oral reading task, were highly significant ($r = .72$ to .88, $p < .0001$ for all pairs), suggesting a common source of variance for these tasks.

HG's identical pattern of semantic errors in naming, comprehension, repetition, and dictation tasks provides evidence that errors arise in a process common to all these tasks—the semantic system. Hence detailed analyses of HG's performance across tasks indicated two levels of breakdown in naming: (1) accessing complete semantic information and (2) retrieving the phonologic representation. Of course, only the former affected written naming.

TABLE 24-1. ERROR RATES ACROSS TASKS

	Total errors		*Semantic errors*		
	NUMBER	PERCENT OF RESPONSES	NUMBER	PERCENT OF RESPONSES	PERCENT OF ERRORS
Written name	100	69.5	42	29.2	42.0
Verbal name*	86	59.7	42	29.2	48.9
Dictation	97	67.4	41	28.5	42.3
Repetition	93	64.6	42	29.2	45.2
Printed word picture matching	37	25.7†	37	25.7	100
Auditory word picture matching	41	28.5†	41	28.5	100

*Verbal responses were scored as correct, semantic errors, or other word errors if they were understood as such, even if they were mispronounced (usually as phonologically plausible renditions of the target or semantically related word). For example, [tɪgɑ] was scored as a correct response in naming a pictured tiger and as a semantic error in naming a pictured lion.

†These rates are lower than those of other tasks, because HG never failed to respond in this task. Her nonsemantic errors on the other tasks were primarily nonresponses, and the remainder were unrecognizable responses (which are not possible on the word picture matching task).

PART 2: TREATMENT

HG's coordinate semantic errors (e.g., tiger → "lion") in naming and comprehension tasks suggest that her semantic impairment entails degraded distinctions between related words. For example, in naming, an impoverished semantic representation of "tiger" (perhaps sufficient to identify it as a feline) might activate output representations for both tiger and lion. Therefore, treatment of the semantic deficit was designed to teach distinctions between related items.

METHODS

Experimental stimuli, set 1, consisted of 50 line drawings and corresponding printed or auditory words. Control stimuli, set 2, were semantically unrelated to the trained stimuli and were matched to the former in length and frequency.

Baseline measures of written naming, repetition, dictation, reading, and verbal naming were obtained by presenting 10 items from set 1 and 4 items from set 2 for each task without feedback. Both lexical accuracy and phonemic accuracy of verbal responses were scored. For lexical accuracy, any recognizable, appropriate word was scored as correct; single-letter spelling errors or phonemic errors were not penalized. Interjudge reliability between two independent scorers on 100 responses on each task was 100 percent (point to point) agreement for lexical accuracy and 97 percent for phonemic accuracy.

After 6 baseline sessions, treatment S ("semantic") was initiated to improve written naming. Ten random stimuli from set 1 were presented. Following each semantic paraphasia, the referent of the subject's response was drawn, and contrasting semantic features between her response and the target were identified. For example, if HG wrote "lemon" in response to a picture of a cherry, the clinician drew a lemon and pointed out perceptual differences between a lemon and a cherry (yellow/red, elliptical/round, sour/sweet, tough/tender skin, and so on). Baseline measures of the remaining tasks for set 1 and all tasks for set 2 continued, to evaluate generalization across modalities and across stimuli. Word picture matching with all set 1 stimuli was probed every fifth session, so that stimuli were presented equally often in all modalities.

When HG reached criterion of 100 percent accurate, independent written naming of set 1, treatment S began with set 2. Simultaneously, treatment P ("phonemic") was initiated for set 1 stimuli, in the oral reading task only, to improve phonemic accuracy of HG's now lexically correct responses. She was taught correct phonemes by presenting phonetic spellings. For example, after HG read "knuckles" as [kənuklɛs], the stimulus was rewritten as "nakalz," and HG's oral reading response was shaped until she pronounced the word correctly. Phoneme accuracy was measured in oral naming and repetition with no feedback. When HG reached 100 percent lexically correct responses on set 2, treatment P was then applied to this second set.

RESULTS

Written naming performance improved with the semantic intervention. HG showed generalization of improved lexical accuracy across all modalities (Fig. 24-1). There was no evidence of generalization to set 2 stimuli (line 7) or to phonemic accuracy in oral responses to trained stimuli (line 6). The subsequent improvement on set 2 when treatment was initiated established a functional relationship between teaching semantic distinctions and improved lexical accuracy. Consistent with this conclu-

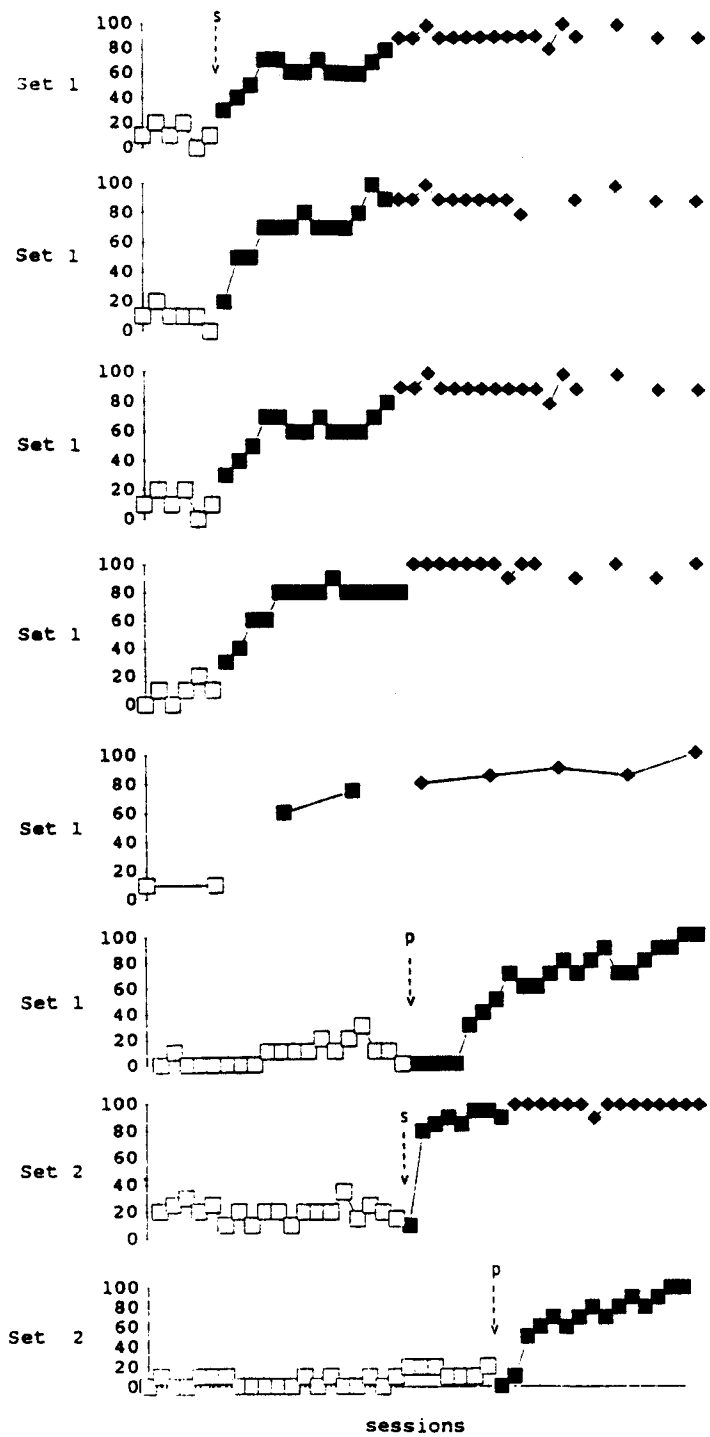

Fig. 24-1. HG's performance on treated and untreated tasks (percentages). 1: lexically correct written naming before feedback. 2: lexically correct oral naming with no feedback. 3: lexically correct repetition with no feedback. 4: lexically correct writing to dictation with no feedback. 5: correct auditory word picture matching with no feedback. 6: phonemically correct oral reading before feedback. 7: lexically correct items in set 2 before feedback. 8: phonemically correct oral reading of set 2 before feedback. Open squares = no treatment (for the dependent variable—either lexical or phonemic accuracy) applied to the set in any task. Closed squares = trials during treatment phases for the dependent variable.

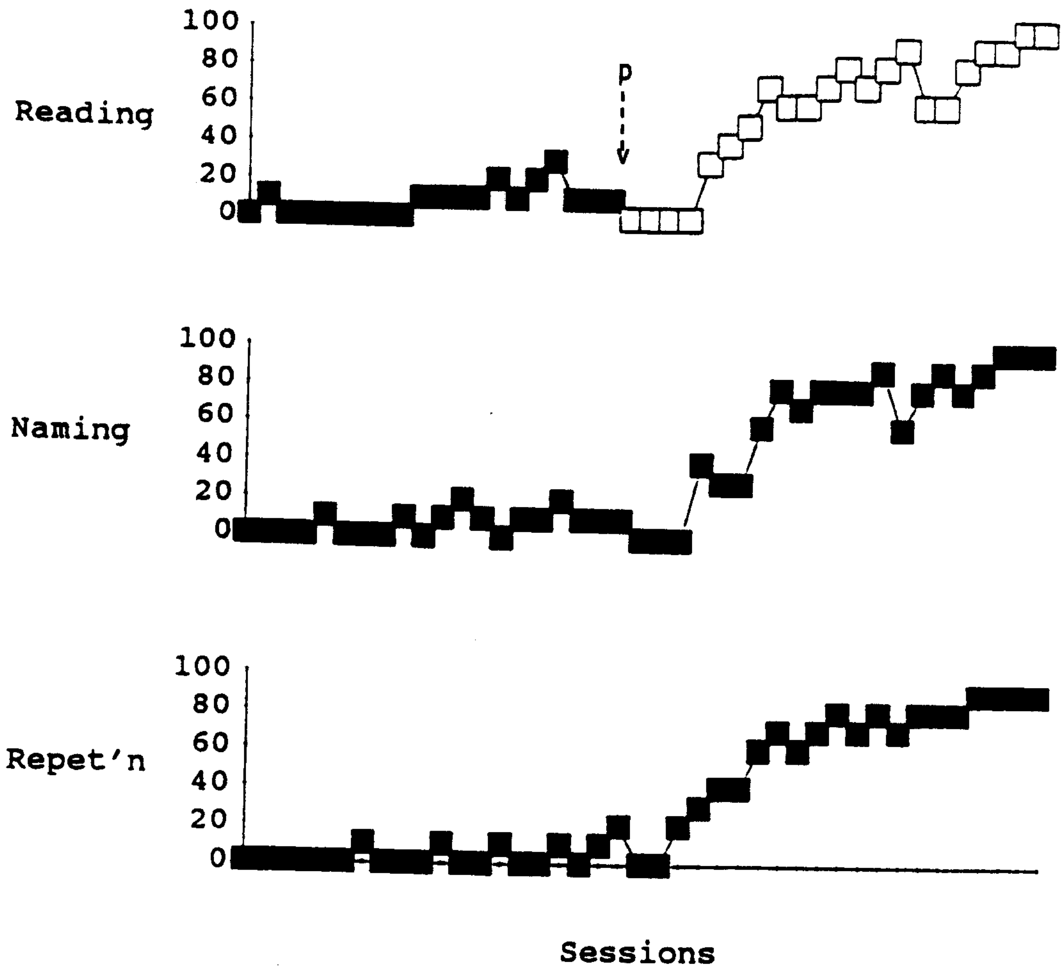

Fig. 24-2. Generalization of improved phonemic accuracy to untrained tasks for set 1 stimuli. Open squares represent trials on which treatment P was applied after the initial response was scored.

sion, treatment S also was associated with reduced semantic errors in all the tasks.

Phonemic accuracy of oral reading improved when treatment P was applied to each set sequentially, as shown on lines 6 and 8 in Figure 24-1. Further, generalization of phonemic accuracy to untrained tasks of oral naming and repetition with the same stimuli occurred in association with treatment applied only in the reading task (Fig. 24-2).

DISCUSSION

At least three alternative mechanisms for the improvements associated with treatment S may be advanced: (1) reinforcing correct naming improved general word-retrieval strategies (Mills et al., 1979); (2) eliciting correct written naming responses improved access to the orthographic representation of those words on subsequent trials (Hillis, 1989); or (3) teaching semantic distinctions between trained items and related items resulted in relearning of or improved access to semantic information. The first hypothesis was rejected because generally improved word-retrieval strategies should affect untrained items as well as trained items. Such generalization across items was not demonstrated. The second hypothesis was ruled out because improved access to the orthographic representation would not be expected to influence repetition or word picture matching. Generalization of gains to all lexical tasks was documented. Further, improving access to the orthographic representation of trained words (hypothesis 2) should not increase the probability of producing *any* untrained words. In contrast, learning semantic distinctions between trained items and related items (hypothesis 3) might increase the probability of producing trained words as correct responses and reduce the probability of producing trained words as error responses to untrained, related stimuli. For example, enhanced ability to semantically differentiate "tiger" (trained) from "lion" (untrained) might improve naming of both tiger and lion. Pretesting and posttesting confirmed significantly increased accuracy of naming untrained, semantically related items, while naming of unrelated items did not improve without treatment (Table 24-2). Generalization across modalities and to untrained, related stimuli is consistent with (re)establishment of distinctions between related items at the semantic level with treatment S.

Increased phonemic accuracy in producing each trained stimulus across oral tasks with treatment P might be explained by either (1) improved articulatory processes (e.g., motor programming) or (2) improved access to or relearning of phonologic representations of these words. HG's plausible phonemic renditions of each letter sequence prior to treatment point to the latter explanation. In other words, there was evidence for excluding motor speech deficits as the cause of her errors.

In conclusion, evidence was obtained for specific effects of a *phonemic* retraining strategy at the level of the phonologic output lexicon and specific effects of *semantic* remediation strategies at the level of the semantic system for trained words. As forewarned in the introduction, these results are hardly earth-shattering. The procedures were intuitively based on the hypothesized disruptions in the naming process that gave rise to the patient's errors; that is, she was taught semantic distinctions because she failed to make them, and she was taught the sounds of words because she couldn't retrieve them. It is nice to find out that a severely aphasic patient is capable of such relearning 7 years after onset. More important, however, this study serves to illustrate the usefulness of dis-

TABLE 24-2. RETESTING RELATED AND UNRELATED WORDS

	Pretest				*Posttest*			
	Total errors		*Semantic errors*		*Total errors*		*Semantic errors*	
	NUMBER	PERCENT	NUMBER	PERCENT	NUMBER	PERCENT	NUMBER	PERCENT
Untrained words in same semantic category as trained words:*								
Oral name	32	(34.0)	19	(20.2)	16	(17.0)	6	(6.4)
Written name	30	(31.9)	13	(13.8)	20	(21.3)	5	(5.3)
Repetition	36	(38.3)	15	(16.0)	28	(29.8)	6	(6.4)
Dictation	32	(34.0)	14	(14.9)	19	(20.2)	5	(5.3)
Printed word picture matching	N/A		17	(18.1)	N/A		8	(8.5)
Auditory word picture matching	N/A		16	(17.0)	N/A		7	(7.4)
Untrained words in different semantic categories from trained words:†								
Oral name	15	(37.5)	10	(25.0)	15	(37.5)	10	(25.0)
Written name	14	(35.0)	9	(22.5)	14	(35.0)	10	(25.0)
Repetition	15	(37.5)	10	(25.0)	15	(37.5)	11	(27.5)
Dictation	17	(42.5)	12	(30.0)	16	(40.0)	10	(25.0)
Printed word picture matching	N/A		12	(30.0)	N/A		11	(27.5)
Auditory word picture matching	N/A		11	(27.5)	N/A‡		11	(27.5)

*N = 94; $\bar{X}$ word frequency = 25.5; $\bar{X}$ length in letters = 5.12.
†N = 40; $\bar{X}$ word frequency = 24.8; $\bar{X}$ length in letters = 5.61 (nonsignificant differences between sets).
‡Not applicable because only semantic foils and targets were tested.

entangling the various possible sources of each patient's errors in tasks such as naming that involve a multitude of cognitive processes.

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