Clinical Aphasiology, Vol. 22, 1994, pp. 245–256

Feature Analysis for Treatment of Communication Disorders in Traumatically Brain-Injured Patients: An Efficacy Study

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According to Szekeres, Ylvisaker, and Cohen (1987), disturbances in organization interfere with extensive searches of the knowledge base after traumatic brain injury and, therefore, compound retrieval problems. Feature Analysis (Szekeres et al., 1987) is a protocol designed to promote organization of verbal output and increase the amount of information retrieved.

The Feature Analysis treatment (see Appendix A) involves considering any familiar concept and describing it in terms of six predefined descriptors (Group, Action, Use, Location, Properties, and Associations). Patients are taught to use the procedure as a strategy for facilitating the retrieval of additional information about a concept. Feature Analysis is based on a semantic network theory of storage and retrieval (Anderson, 1983). Prior to this study, the program had not been operationally specified, and its efficacy had not been established.

This investigation was designed to develop a systematic protocol for Feature Analysis training and to determine its efficacy in treating communication disorders of two patients with traumatic brain injury.

METHOD

Subjects

Subject 1 was a 24-year-old male, 5 years post injury, with 14 years of premorbid education. Subject 2 was a 28-year-old female, 12 years post injury, with 11 years of premorbid education. Both were diagnosed as sustaining severe traumatic brain injury, the result of a fall and of a motor vehicle accident, respectively. Spoken output was telegraphic in nature and resembled that of Broca's aphasia. Details regarding selected clinical characteristics appear in Appendix B (see Massaro, 1991, for specific inclusion criteria).

Stimuli

Subjects ranked various topics for interest and knowledge, and those rated high across both dimensions were used for training. Three superordinate categories (e.g., Animals) with six subtopics each (e.g., Dogs) were identified for each subject. Topics were arranged in pairs according to their semantic features. One member of each pair was randomly selected as a training topic, and the other served as a generalization topic (see Table 1).

Table 1. Training and Generalization Stimuli

Superordinate	*Training*	*Generalization*
	Subject 1	
Animal	Rabbit Turtle Cat	Hamster Fish Dog
Exercise	Jogging Swimming Aerobics	Walking Yoga Dancing
Leisure	Reading Picnicking Concerts	Photography Dining Movies
	Subject 2	
Animal	Rabbit Cat Turtle	Hamster Dog Fish
Leisure	Picnicking Concerts Shopping	Dining Movies Dancing
Sports	Hockey Soccer Golf	Baseball Football Tennis

Experimental Design

A multiple baseline design across superordinate categories was used. Responses were analyzed for number of semantic features listed and number of semantic descriptors accessed per topic. Probe data were collected in an identical fashion across baseline, training, and maintenance phases (see Massaro, 1991, for probe schedule). The subjects were asked to state all they knew about the topic presented. Two trials were always given: an unstructured trial followed by a structured trial in which a blank Feature Analysis format was provided.

Stimulus Generalization

To assess stimulus generalization, each subject was probed with two unfamiliar listeners (one male, one female, both about 50 years of age) on two separate occasions prior to baseline. On each occasion, one unfamiliar listener introduced a training topic from the superordinate ranked as highest interest and knowledge, and the other unfamiliar listener introduced a generalization topic from the same superordinate. The subjects were asked to state all they knew about each topic. This same procedure was repeated with the same unfamiliar listeners immediately after training. Two weeks after training ended, the subjects were probed with the same topics by their speech-language pathologist, a familiar listener who was unaffiliated with the Feature Analysis training.

Training Procedures

Each of the three training topics for a given superordinate category was trained each session. If cuing was necessary to elicit appropriate responses, cues were systematically provided (see Table 2 for hierarchy). Cues were given after a 15-second delay, requests for help, rejection of the task, or incorrect responses. Training proceeded until all six semantic descriptors were accessed or the complete set of cues was presented without success.

During the final three training sessions, the Feature Analysis chart was shrunk to credit card size to promote compensatory use of Feature Analysis as a self-cuing system.

Social Validation

To determine whether persons unfamiliar with the subjects and the targeted behaviors could detect changes in verbal output, four speech-language

Table 2. Cuing Hierarchy With Example Cues for Target Response

Cue Type	*Example*
Redefinition of category	The location is where the movie is found.
Sentence completion	You watch the movie in the . . . .
Writing initial letter	t . . .
Producing initial phoneme	/th/ . . .
Binary choice question	Is it a theater or a stadium?
Yes/no question	Is it a theater?
Requesting imitation	Say, "Theater"

Note: Target response = *theater,* in the descriptive category *Location,* under the topic *Movie.*

pathologists listened to tape-recorded samples of the subjects' performances. Samples were randomly selected from structured trials within the baseline and maintenance conditions for each subject. Judges rated the samples along the dimensions of organization, cohesion, and completeness, using the following operational definitions: *organization*—the sample has an inherent structure (a beginning, middle, and ending); *cohesion*—each individual unit of the sample has a relationship to other units; *completeness*—the topic is discussed in full detail. A direct magnitude estimation procedure was employed (Campbell & Dollaghan, 1992).

RESULTS

Training Data

Table 3 summarizes the number of cues used during training. As training progressed, the amount of cuing decreased for both subjects, but Subject 2 required more cues per trial than Subject 1.

Treatment Effects

Probe data for mean number of features listed by each subject are presented in Figures 1 and 2. Results are not provided for number of descriptors accessed because the trends are identical (see Massaro, 1991).

Data for training and generalization topics were collapsed for baseline and training conditions, because the number of probes per session was not the same for each type of topic and the data could not be converted to

Table 3. Summary of Cues Used During Training

Subject 1		*Subject 2*	
Session	*No. of Cues*	*Session*	*No. of Cues*
Exercise		Animals	
1	27	1	21
2	14	2	14
3	11	3	13
4	0	4	9
5	3	5	8
6	3	6	9
7	1	7	7
8	3	8	5
9	0	9	8
Animals		Leisure	
10	8	10	17
11	2	11	17
12	5	12	7
13	1	13	8
14	0	14	5
15	0	15	5
Leisure		Sports	
16	4	16	12
17	3	17	6
18	1	18	7
19[a]	2	19[a]	3
20[a]	2	20[a]	4
21[a]	0	21[a]	1
Total	90	Total	186

[a]Denotes sessions in which prosthesis-sized Feature Analysis chart was used for training.

a common scale. However, performance was highly similar across training and generalization topics. Training and generalization data are graphed separately for maintenance probes because the number of trials per session was the same for each type of topic.

As indicated in Figure 1, Subject 1 displayed variable performance during baseline. The rising baseline is dramatic for Superordinate 2 (Animals), suggesting a possible loss of experimental control. If this were the case, however, we would predict an even more dramatic pattern during baseline for Superordinate 3, which did not occur.

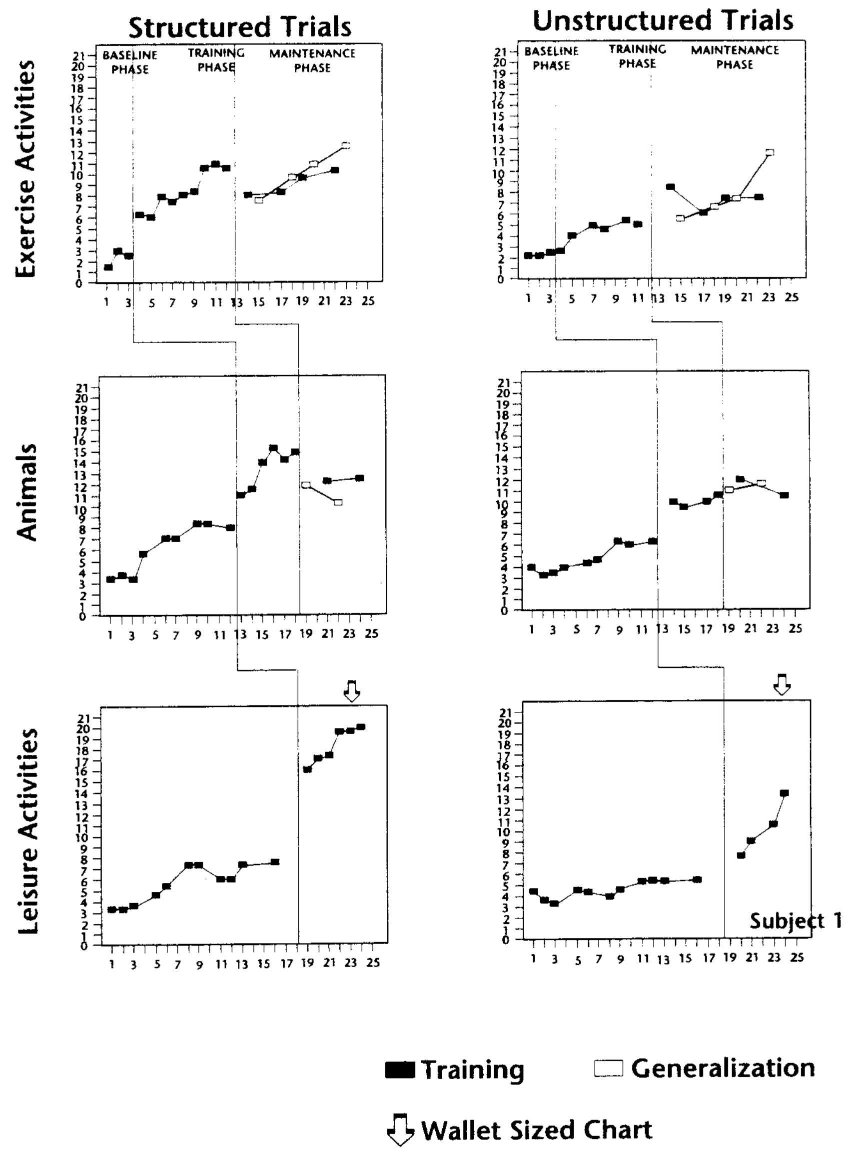

Figure 1. Mean features listed by Subject 1 across superordinates and experimental phases.

Treatment effects were demonstrated during the training phases. Subject 1 performed optimally on structured trials during training and maintained performance at levels comparable to or greater than training. As the open boxes show, response generalization to untrained topics was achieved.

Figure 2 shows that Subject 2's baseline performance was more stable. Treatment effects were demonstrated, and Subject 2 also performed optimally on structured trials during training. Subject 2's performance decreased during maintenance yet remained above baseline levels. Again, response generalization was achieved.

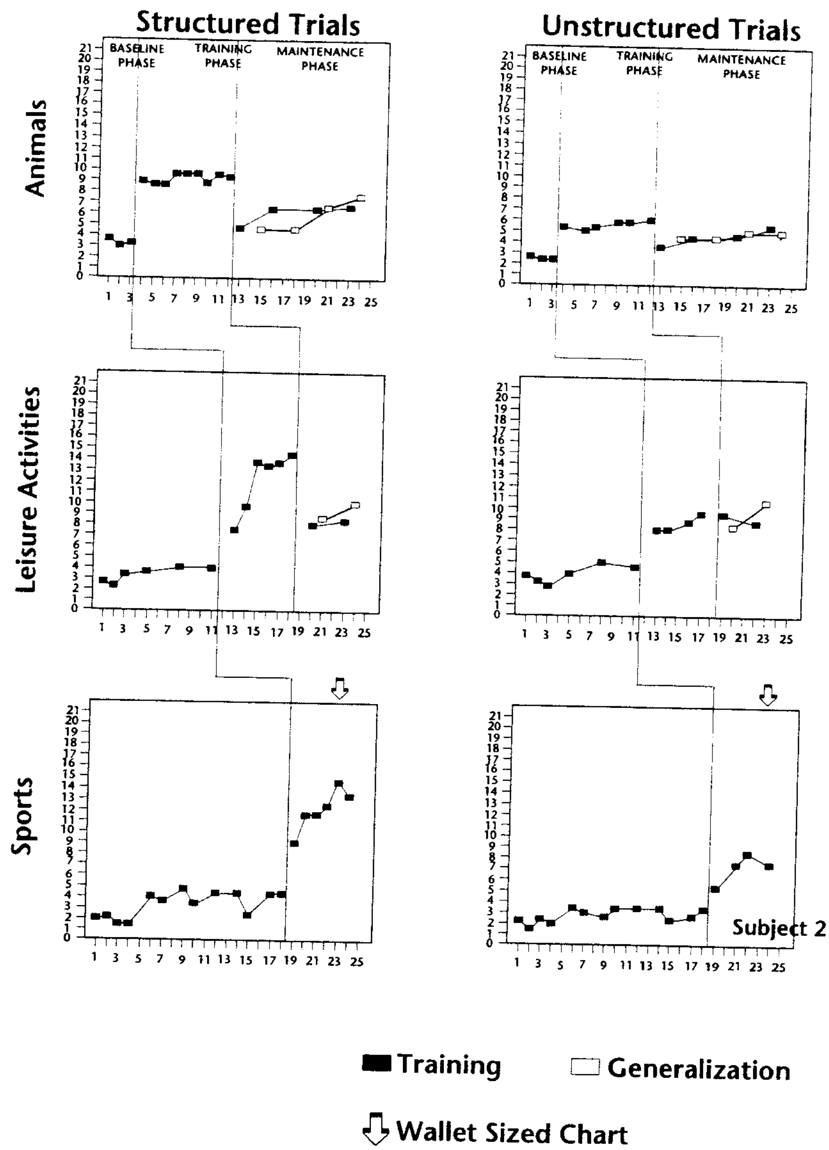

Figure 2. Mean features listed by Subject 2 across superordinates and experimental phases.

Stimulus Generalization

Although both subjects demonstrated generalization to untrained topics, neither made notable improvement from before to after therapy with unfamiliar listeners (see Table 4). Subject 1's performance improved with his speech-language pathologist, who is a familiar listener. No notable change occurred for either subject when the miniaturized Feature Analysis chart was provided as a self-cue.

Table 4. Summary of Conversational Generalization Measurements

	Total No. of Features	
Measurement	*Subject 1*	*Subject 2*
Pretherapy probes (unfamiliar listener)[a]	2.5	2.0
Posttherapy probes (unfamiliar listener)[a]	2.8	3.5
Follow-up with speech-language pathologist (unstructured trials)[b]	8.0	5.5
Follow-up with speech-language pathologist (structured trials—prosthesis-sized chart)[b]	9.0	5.0

[a]Data are averages obtained with two different listeners on two separate occasions.
[b]Data are averages for two probes with one familiar therapist.

Social Validation

As noted in Table 5, Subject 1's verbal output was judged to improve in organization, but cohesion was noted to deteriorate slightly from baseline to maintenance. Completeness was rated somewhat more favorably for the maintenance probes. Subject 2's samples were judged as having decreased in organization; however, cohesion was rated much higher during maintenance. Ratings of completeness were equivalent across conditions.

DISCUSSION

The results indicate clear treatment effects, maintenance, and response, generalization for both subjects. Stimulus generalization was disappointing, but this is not especially surprising, because training trials were massed without variation and neither trainer nor setting were varied. Social validation ratings were also modest and inconsistent. Most perplexing were the ratings of completeness, which were not perceived to improve even though each subject listed many more features during maintenance probes. Listeners may have been distracted by the poor organization and cohesion of the samples they heard, as well as by the telegraphic nature of the subjects' verbal output.

Results of this study have several clinical implications. Feature Analysis may be a useful tool for tapping existing semantic networks. Subjects with severe verbal memory deficits retrieved many more semantic features of a topic after being trained. Subjects performed optimally during

Table 5. Social Validation Ratings

	Organization			
	SUBJECT 1		SUBJECT 2	
Rater	*Baseline*	*Maintenance*	*Baseline*	*Maintenance*
1	2	5	2	1,1[a]
2	3	7	3	2,1[a]
3	3	5	5	1,2[a]
4	2	4	3	0,0[a]
	Cohesion			
	SUBJECT 1		SUBJECT 2	
Rater	*Baseline*	*Maintenance*	*Baseline*	*Maintenance*
1	2,2[a]	1	0	3
2	2,2[a]	1	1	5
3	4,3[a]	2	1	3
4	3,3[a]	2	0	2
	Completeness			
	SUBJECT 1		SUBJECT 2	
Rater	*Baseline*	*Maintenance*	*Baseline*	*Maintenance*
1	2	4	2,2[a]	3
2	3	4	3,4[a]	3
3	3	4	4,3[a]	3
4	3	5	3,3[a]	3

[a]Denotes sample repeated for intrarater reliability.

structured trials in which they were provided with a Feature Analysis chart; thus, Feature Analysis may be useful as a model procedure for patients who respond well to visual cuing systems. Future research should aim to promote generalization to novel settings and conversational partners by using loose training procedures (Thompson, 1989) and by varying treatment settings, trainers, and even the position of the descriptors on the Feature Analysis chart. The utility of training with a miniature format and of teaching subjects to self-cue in conversational contexts also needs to be examined in a more comprehensive fashion. With proper training in the use of a self-cuing system, patients with traumatic brain injury who benefit from visual cues may be able to adopt a procedure like Feature Analysis as a compensatory aid.

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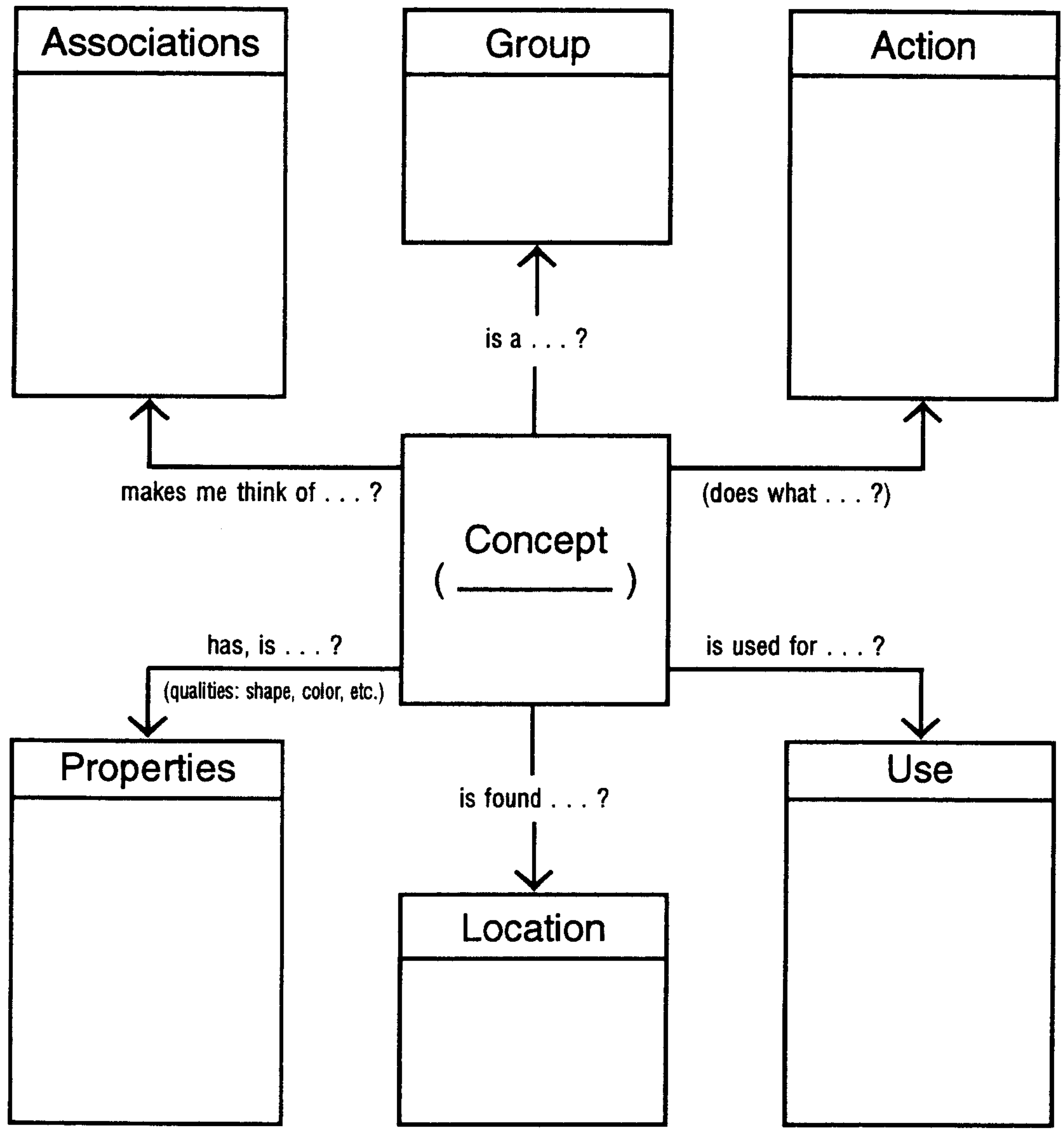
APPENDIX A


Associations
Group
Action
is a . . . ?
makes me think of . . . ?
(does what . . . ?)
Concept
(________)
has, is . . . ?
(qualities: shape, color, etc.)
is used for . . . ?
Properties
is found . . . ?
Use
Location

APPENDIX B

1. To rule out severe comprehension deficits, the auditory comprehension subtests of the *Boston Diagnostic Aphasia Examination* (Goodglass & Kaplan, 1983) were administered.

Auditory Comprehension Summary Profile

Test Component	*Subject 1*	*Subject 2*
Word Discrimination	100	100
Body Part Identification	60	70
Commands	70	90
Complex Ideational Material	70	80

Note: Data are percentiles based on aphasic adults' performance.

2. Various subscales of the *Wechsler Memory Scale–Revised* (WMS–R) (Wechsler, 1987) were administered to obtain a baseline of each subject's memory capabilities. Visual memory was superior to verbal memory for both subjects.

Wechsler Memory Scale–Revised Summary Profile

Subscale	*Subject 1*	*Subject 2*
Verbal Memory (74 maximum)	32	16
Story retelling		
Verbal paired associates		
Visual Memory (69 maximum)	69	60
Figural memory		
Visual paired associates		
Visual memory span		
Visual reproduction		
General Memory (143 maximum)	101	76
Verbal and visual		
Profiles combined		
Attention/ (82 maximum)	36	34
Concentration		
Digit span forward and		
Digit span backward		