EFFICACY OF SEMANTIC FEATURE ANALYSIS AS A TREATMENT FOR WORD RETRIEVAL DEFICITS IN INDIVIDUALS WITH BROCA'S APHASIA

[1]Revathi Magesh, & [2]Gouri Shanker Patil

Abstract

The present study addressed efficacy of Semantic Feature Analysis (SFA) as a treatment technique for word retrieval deficits in Telugu speaking individuals with Broca's aphasia, and to assess the generalization of trained items to untrained across the same and different semantic categories. Three Telugu speaking individuals with Broca's aphasia participated in the study. A discrete trial treatment design was used to examine both acquisition and generalization effects of treatment. The SFA protocol using treatment pictures (animal category) was administered for 6 weeks. Naming skills were tested with untrained items within the same semantic category every 2nd week. At the end of sixth week, both trained and untrained animals names were probed. The probes for animals list continued for the next 3 weeks. At the end of 9th week, naming skills for birds and vehicles were tested and the WAB test was re-administered. Maintenance effects were assessed at the end of 12 and 18 weeks. The results of WAB before and after use of the SFA protocol, baseline naming scores, scores obtained at the end of 2nd week, 4th week, 6th week, 9th week, 12th week and 18th week were tabulated and analyzed. A <0.05 of significant difference was observed for WAB scores before and after therapy indicating an objective evidence for the efficacy of SFA as a treatment option. To establish the difference in naming skills after the use of SFA, the naming subtest scores were subjected to paired samples t-test. Mean scores in the naming subtest of WAB pre & post therapy were 3.1 & 6.2 respectively. The present study suggests SFA strengthens association between target word and its prototypical semantic characteristics thereby facilitating word retrieval.

Keywords: *SFA, Word Retrieval Deficits*

Introduction

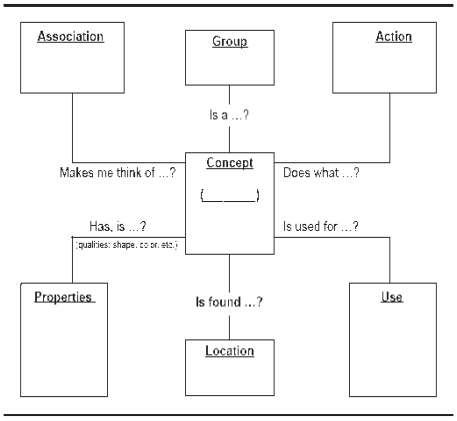
Aphasia is a language disorder which frequently impairs the ability to produce a desired target word or generate sentences. Naming deficits are common in aphasia regardless of its subtype and semantically based errors are also frequently observed (Ardila & Roselli, 1993; Drew, Thompson, & Abaza, 1999; Hillis, 1989; Kohn & Goodglass, 1985). In Telugu speakers with aphasia, Bhan & Chitnis (2013) reported word finding difficulty marked by semantic and phonemic paraphasias in narrative discourse in a client with subcortical aphasia presenting both fluent and nonfluent aphasia characteristics. Previously, Nagendar and Ravindra (2012) found significant word retrieval deficits in Telugu speaking persons with left hemisphere damage (LHD). In another study, Alladi, Mridula, Mekala, Rupela, & Kaul (2010) reported word retrieval deficits in 2 persons with post-stroke fluent aphasia. In individuals with Broca's aphasia confrontation naming is markedly affected. Treatment of naming abilities by speech-language pathologists may be the main focus of therapy if deficits are prominent (Howard, Patterson, Franklin, Orchard-Lisle, & Morton, 1986). Retraining the names of all of the objects and people in an individual's personal lexicon is not considered an effective therapeutic method and generalization for confrontation naming tasks is often limited (Nickels, 2002). Recognizing the role of semantic system in comprehension and retrieval of words, some comprehension treatments were developed to facilitate word-retrieval abilities (Marshall, Neuburger, & Phillips, 1990). One of these types of semantic treatments, developed on the basis of cognitive theories of how semantic representations are structured is the semantic feature analysis (SFA) training. The SFA is designed to improve lexical retrieval by increasing the level of activation within a semantic network (Boyle & Coelho, 1995). The SFA rationale is based on the fact that vocabulary becomes more automatic when the neural connections between the semantic concepts within the semantic system are strengthened. The target is more likely to be retrieved and produced when the entire surrounding semantic network is activated (Davis & Thompson, 2005). The SFA procedure employs the use of multiple forms of input for naming, including the written labels of semantically related features, pictures and functional verbal prompts from the speech

[1]Revathi Magesh, Clinical Supervisor, Dr. S. R. Chandrasekhar Institute of Speech & Hearing, Bengaluru, E-mail: revathi.aslp@gmail.com, & [2]Gouri Shanker Patil, Lecturer, Ali Yavar Jung National Institute for the Hearing Handicapped-Southern Regional Center (AYJNIHH-SRC), Hyderabad, E-mail: gourishanker07@rediffmail.com

language pathologist. Peach and Reuter (2010) tested generalization of improved word retrieval to discourse production using the SFA in 2 persons with anomia. The investigators found positive impact of SFA in word retrieval at discourse level.

In SFA procedure, the client is presented with a common picture and is asked to name it. If the client is unable to do so, then he/she is given probes to produce words that are semantically related to the target and is given prompts with questions to provide information about distinctive semantic features associated with the target word that is difficult to retrieve. The therapist assists the client in answering a set of questions about the target by writing and verbalizing responses. A mapping form with sample questions listed on it is used for this process. This process provides both auditory and visual cues, and if the individual is unable to name the target once the map is completed, then the SLP provides the name of the stimulus and the client repeats it.

The mapping form of SFA is as follows:



The use of SFA for facilitating word retrieval is well documented in the western studies. The research done in this area in aphasics speaking Indian languages is little. The current study was needed to address issues related to efficacy of SFA in Telugu speaking individuals with aphasia. The current study also addresses another facet of exploring whether SFA would help in generalization from trained to untrained items within the same semantic category (e.g., animals) or a related category (e.g., birds, since both are animate) or a completely different class (e.g., vehicles).

Method

Three Telugu speaking individuals with Broca's aphasia were selected with inclusion criteria of a single left hemisphere stroke in the middle cerebral artery confirmed by a CT/MRI scan and post stroke duration of at least 6 months. All the 3 participants in the study had received some traditional approaches of language treatment during the initial months following their stroke. The Western Aphasia Battery (WAB) was administered to establish the pre-therapy naming subtest scores and to determine the type of aphasia. The Table 1 presents WAB scores for the 3 participants.

A set of black and white line drawings belonging to semantic categories of animals, birds and vehicles were developed and standardized by 50 normal young and adult individuals for name agreement, image agreement, familiarity, and visual complexity on a Likert 5 point rating scale. These items were not part of the WAB. The *name agreement* was defined as relevance of the noun to that of the target item on the card. *Imageability* was defined as the ease with which a word gives rise to a sensory mental image (Paivio, Yuille, & Madigan, 1968).

Table 1: WAB scores of all the three participants

Participant	Fluency	Comprehension	Repetition	Naming	Apraxia Score	WAB Impression
P1	3.0	8.25	2.8	3.0	58	Broca's Aphasia
P2	3.5	8.65	2.8	3.2	51	Broca's Aphasia
P3	3.0	8.35	1.9	3.1	55	Broca's Aphasia

Familiarity was defined as the degree to which one came in contact with or thought about the item on the card (George & Mathuranath, 2007). *visual complexity* was defined as the amount of detail or intricacy of lines in the drawing and not the concept it represented (George & Mathuranath, 2007). The mean scores were obtained for each variable and rank ordering was carried out accordingly. After this, 4 lists - List I, List II, and List III & List IV were prepared

based on mean scores. Appendix I shows the four lists used for the study. The components of semantic features considered in the current study were association, group, action, properties, location and use. The same participants who participated in standardizing the stimuli were also asked to list down semantic features of each target word.

The participants were instructed to relate to the semantic features as follows: Association of the target noun was defined as the term that they could easily relate to the target, ex: for the target word /cat/ the association could be a pet. Group was the semantic category to which it belongs to ex: /cat/ belongs to animal group. Action was the verb associated with the target noun, for the same ex. /cat/ the action could be the sound it makes /meow/. Properties were related to the physical attributes of the target, for /cat/, the properties could be soft, fur etc. Location refers to the place where we usually find it or where we place the targets, /cat/ being a pet its location could be at home or on streets also. With regard to the semantic feature "use" not much could be listed as use for all the animals is not significant. Although some of them serve purposes (ex: cow gives milk). Similarly for birds, listing the semantic feature "use" could be difficult. For this reason, the participants were instructed to list what connects to them regarding the use of the target nouns. Once all the semantic features for all the targets were listed, they were tabulated and analyzed to select the most common and most frequently occurring semantic features for use in treatment.

A discrete trial method was used to examine acquisition of trained items and generalization to untrained items within and across semantic categories. The confrontation naming skills of pictures in the three semantic categories were assessed before initiation of the treatment as a baseline scoring measure. The participants were given a time window of 30-seconds. The accuracy of retrieval was of greater interest than the response time. For the purpose of scoring the naming responses, a nominal scale with 0 as incorrect and 1 as correct were used. For the purpose of measuring accuracy of the naming responses, Hillis (1989) suggested to use each item as a percent response to report the accuracy of progress. Following the same, as each list included 10 stimuli, each response 1 was given a 10%. Then the percent number of correct responses were tabulated and calculated. The pre-therapy WAB scores were also taken

Each participant received speech therapy weekly thrice for 1 hour for nine weeks during which the Semantic feature analysis (SFA) protocol was used. The training picture items list was used and the pictures were randomly presented for only once during the session. There was variability among participants with regard to the number of items completed in a session. Thus there were no fixed criteria as to how many pictures to be completed per session, although a target was set that by the end of the sixth week all the ten trained pictures should be completed. The participants were asked to name each picture and the SFA protocol was initiated even if the participant's were able to spontaneously name the picture. The semantic features used by clinician in the initial sessions were those that were developed as per the norms of 50 neurologically normal participants, although the semantic features given by participants during the sessions were made a major focus for an easier retrieval and the features elicited varied from participant to participant. If the picture was named spontaneously without any assistance/prompts from the therapist, it was judged as correct. Incorrect responses such as phonemic paraphasias were not accepted. Prompts such as "this makes me think of," "this is used for," or "this is found" were used to form a web of related concepts to the target. If the subject's were unable to provide an answer to each of the prompts, then the clinician will provide it both verbally and also in written from. Sometimes participants attempted for the target word in English. These attempts were not discouraged, but the clinician repeated the target as to "Let's try to recollect it in Telugu and repeated the target in Telugu". After completing the entire protocol, the subjects were again asked to name the picture. If they were still unable to do so, then the clinician provided the response verbally and requested the subjects to repeat it. Appendix II presents with the detailed description of the steps involved in the SFA protocol.

The SFA protocol was continued with the treatment pictures (List I) for six weeks. Naming probes with the untrained items (List II) within the same semantic category were conducted every 2nd week to determine the generalization of naming skills. At the end of the sixth week, naming probes with trained and untrained animal's lists (List I & II) were conducted. After this, the SFA protocol was repeated for both trained and untrained items of animal's category for 3 weeks. At the end of the 9th week naming probes for birds and vehicles list were conducted (List III & IV) to assess the generalization of trained probes to untrained probes across different semantic categories. At the end of the 9th week WAB test was re-administered again.

The maintenance effect was assessed at the end of 12 weeks and 18 weeks.

Results and discussion

(i) Efficacy of SFA in lexical retrieval of nouns belonging to treatment probes: The naming scores for the treatment probes were conducted at the end of the 6th week of SFA protocol. The results are presented in the following Figure 1. BS represents the baseline scores for the treatment probes. TP represents the naming scores of the treatment probes at the end of 6 weeks of SFA therapy. P1, P2 and P3 represent participant 1, participant 2 and participant 3 respectively. The graph shows a clear improvement in the naming skills from the baseline scores to the post therapy scores.

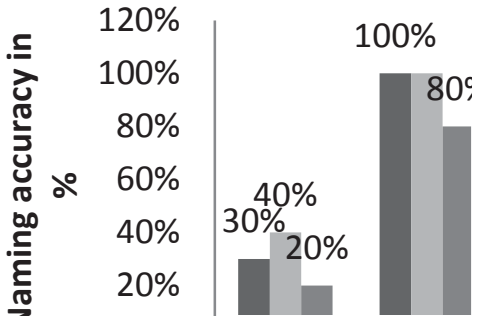


Figure 1: the baseline naming scores and the treatment probe scores by the end of 6 weeks of SFA protocol.

(ii) Efficacy of SFA generalization of the trained items to the untrained nouns belonging to the same semantic category of animals: The naming probes of untrained items within the same semantic category of animals were conducted at the end of 2nd 4th and 6th week of the SFA protocol. During these naming probes, the participants were presented with the untrained picture sets and were asked to name them using SFA technique. No verbal and visual prompts were provided. The results are presented in the following Figure 2. The graph shows a gradual increase of the naming acquisition responses by P1, P2 & P3 for the untrained items in the semantic category of animals across the six weeks of SFA protocol. BS represents the baseline scores. This indicates that the generalization effects for the nouns within the same semantic category are high.

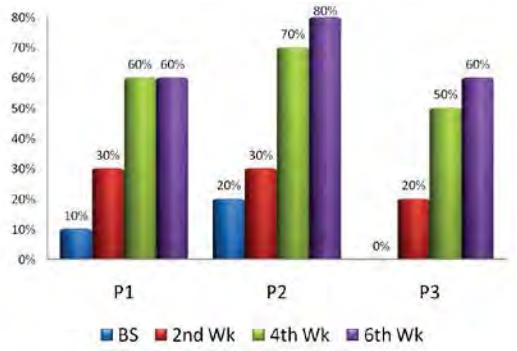


Figure 2: The naming scores for untrained probes across treatment sessions.

(iii) Efficacy of SFA in generalization of the trained items to the untrained nouns belonging to different semantic categories of birds and vehicles: At the end of 9th week of SFA protocol the naming probes were measured for the both the lists in the semantic category of animals and their generalization effects were assessed across different semantic category of birds and vehicles. The results for Participant 1 (P1) indicated the naming accuracy for List II nouns increased from 60% to 90% by the end of 9th week of SFA protocol. The increase in the naming accuracy from 10% to 40% for birds, and 20% to 40% for vehicles was evident, but it was not be considered as a generalization effect, since more than 50% criterion was not met. The naming accuracy for Participant 2 (P2) for List II nouns increased from 90% to 100% by the end of 9th week of SFA protocol. The increase in the naming accuracy from 10% to 40% for birds, and 20% to 40% for vehicles was evident, but it was not be considered as a generalization effect, since more than 50% criterion was not met. The naming accuracy for Participant 2 (P3) for List II nouns increased from 60% to 80% by the end of 9th week of SFA protocol. BS B, GE B, BS V & GE V represent the baseline scores & generalization effects of birds and vehicles respectively. The increase in the naming accuracy from 10% to 40% for birds, and 20% to 40% for vehicles was evident, but it was not be considered as a generalization effect, since more than 50% criterion was not met.

(iv) Efficacy of SFA in Maintenance effects: Maintenance of the naming skills to the trained and untrained items in the semantic categories of animals, birds and vehicles were assessed at 12th week and 18th week. The maintenance period was considered as the time after 9th week of SFA protocol. During this time, no therapy was given with respect to SFA or any other concurrent approach. The consent from the family of the participants was taken for the same. The

maintenance effects for the three participants are presented in the following figure.

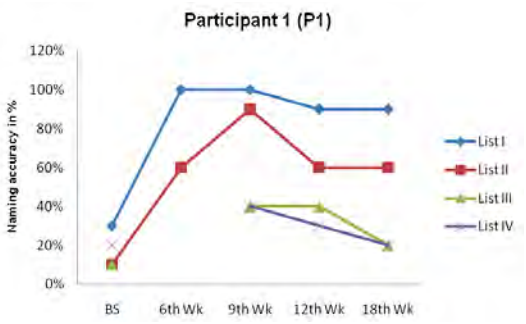


Figure 3: The maintenance effects for P1.

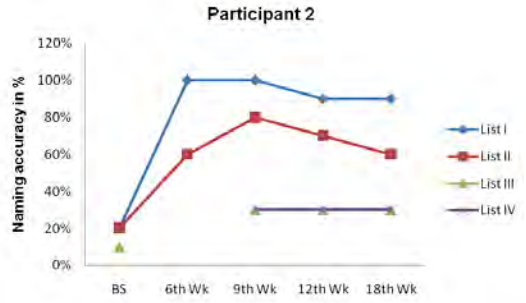


Figure 4 : The maintennace effects for P2

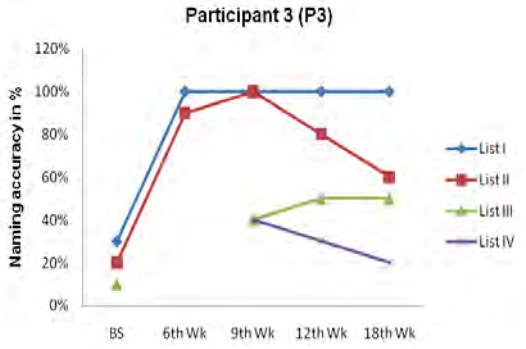


Figure 5: The maintenance effects for P3

The results from the three participants indicate greater gains in maintenance of the achieved targets in List I and List II of the semantic category of animals which were treated for 9 weeks and 3 weeks respectively. This indicates that SFA assists in improved maintenance for the treated probes. Although there was an improvement in the naming scores for all the three participants, the responses were not considered as generalization effects due to not meeting the criterion of 50% or more. Thus, poor generalization and poor maintenance scores are achieved for all the three participants in the semantic category of birds and vehicles. This indicated that SFA assists in greater gains in word retrieval for treated probes and untreated probes under the same semantic categories and modest gains for untrained probes across different semantic categories.

(v) Pre and Post therapy WAB scores: After the 9 weeks of therapy using the SFA protocol, the WAB test was re-administered for all the three participants. The naming subtest scores are presented in the following table.

Table 2 : Pre therapy and Post therapy Naming scores in WAB test

Participants	Naming Scores in WAB	
	Pre-Therapy	Post-Therapy
P1	3.0	5.9
P2	3.2	6.6
P3	3.1	6.1

The table represents an improved score in the naming subtest of WAB from baseline to the post therapy score for all the three participants. The pre-therapy naming scores were 3.0, 3.2 and 3.1 for P1, P2 and P3 respectively. The naming scores improved to 5.9, 6.6 and 6.1 for P1, P2 and P3 indicated that a significant improvement in naming is achieved due to the use of SFA protocol for a period of 9 weeks. To establish the significant difference if any because of SFA, the overall WAB scores and the naming subtest WAB scores were subjected to paired samples t-test. Table 3 presents the mean values and the standard deviation values for the overall WAB scores.

Table 3: Mean and standard deviation values of WAB scores before and after therapy

	Mean	Standard Deviation	Sig. (2 tailed)
WAB scores before therapy	4.30	2.51	0.000
WAB scores after therapy	6.27	1.76	

A significant difference of (<0.05) was observed for the WAB scores before and after therapy indicating an objective evidence for the efficacy of SFA as a treatment option. To establish the difference in word retrieval skills after the use of SFA, the naming subtest scores were alone subjected to paired samples t-test. The results suggested SFA facilitated improved performance of word retrieval skills for the trained items of List I in the semantic category of animals for all 3 participants. The results showed greater gains in retrieval of treatment probes following SFA. The responses from the baseline to the post therapy scores conducted at the end of 9th week and the generalization scores measured at the end

of 12th and 18th weeks also reported greater gains in the maintenance of achieved targets even when the use of SFA protocol was terminated. This is in accordance to the study done by Boyle (2004), Boyle & Coelho (1995) and Mc Hugh & Boyle (2000) who had shown that SFA training improved word retrieval for trained items in participants with aphasia and reported positive generalization and maintenance effects. The use of SFA showed greater generalization to the untrained items within the same semantic category. This improvement in generalization can be attributed to the likelihood of the carryover of the SFA mapping technique to the untrained items. The SFA also facilitated self generation of cues by the participants reflecting improved word retrieval for untrained items. This is consistent with the findings of Boyle, & Coelho (1995), Lowell, Benson, & Holland (1995), and Coelho, Mc Hugh, & Boyle (2000), who reported improved generalization effects of trained nouns to untrained nouns in participants with aphasia. The generalization effects of the trained items to the untrained items across different semantic categories were not reported previously. Thus it cannot be assumed that SFA may not assist in generalization of trained items to untrained items across different semantic categories based on this preliminary finding of the current study.

Conclusions

The results of the present study supports the use of SFA as a functional therapeutic means of facilitating naming. Thus it can be inferred that strengthening the associations between a target word and its prototypical semantic characteristics results in a greater ease with which the words are retrieved. As SFA is a self generated cueing strategy, it can be inferred from the present study that self-generated cueing behaviors (client generated) should be regarded as potentially useful ways of transferring information, because a patient's success at retrieving a specific target word bore no apparent relationship to successful observer identification (observing clinician generating cues). Certainly, a therapy focus that encourages the use of clear self-cues regardless of eventual word production should be considered for many adults with aphasia. Also, this technique teaches individuals a process of thinking and generating language using a purposeful, step-by-step format that helps in self generating cues in non-clinical settings also.

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Appendix I

	List I	List II
Sl. No	**Target items for treatment probes**	**Target items to assess generalization within the same semantic category**
1	/pɪllɪ/	/ dʒɪnkɑ/
2	/tʃe:pɑ/	/pʊlɪ/
3	/ɑ:vu/	/eluka/
4	/me:kɑ/	/tʃɪrʊθʌ pʊlɪ/
5	/gʊrrʌm/	/elʊgʊ bʌnti/
6	/kʊkkɑ/	/mosɑlɪ/
7	/e:nʊgu/	/kʌppɑ/
8	/pɑ:mu/	/dʒɪrɑfɪ/
9	/pi:ðʌ/	/pʌndɪ/
10	/onte/	/kʌngɑ:ru/

	List III	List IV
Sl. No	**Target items to assess generalization across related semantic category (birds)**	**Target items to assess generalization across unrelated semantic category (vehicles)**
1	/ bɑ:ðu/	/vɪmɑ:nʌmu/
2	/ v tʃɪlukɑ/	/ɑmbʊlensʊ/
3	/ gʌddɑ/	/pʌdʌvɑ/
4	/ ko:dɪ/	/edlɑ bʌndɪ/
5	/ gʊdlʌ gu:bɑ/	/bʌssʊ/
6	/ nemɑlɪ/	/kɑ:rʊ/
7	/ pɑ:vʊrʌm/	/spɪkɪlʊ/
8	/ hʌmsɑ/	/rɒketʊ/
9	/ gʊvvɑ/	/rɑɪlʊ/
10	/ degɑ/	/vdʒi:pʊ/

Appendix II
Treatment Procedure of SFA

I Clinician presents picture of target item in center of semantic feature chart.

A. Clinician requests naming response from participant.

1. If correct response: verbal feedback is provided (i.e., .That's right. Now let's go through the features.).
2. If incorrect response: verbal feedback is provided (i.e., .Not quite. Let's see if we can trigger it by going through the features.).

B. Regardless of whether naming response is correct or incorrect, the participant is guided through semantic features for target item.

1. Clinician writes features in the appropriate location on the feature chart after the participant identifies them. Clinician writes all appropriate features provided by the participant.
2. If participant is unable to provide a feature, the clinician provides an appropriate feature both verbally and in writing.
3. Clinician completes all features even if correct naming response occurs while reviewing features.

C. After completing all the features, the clinician requests a naming response again.

1. If correct response: verbal feedback is provided (i.e., .That's right.) and new stimulus item is presented.
2. If incorrect response: the clinician will model the target word and request a repetition. If correct production is still not elicited the clinician will attempt integral stimulation to elicit the target word.
3. with incorrect response: clinician reviews the features again with participant by providing a neutral beginning for each feature (e.g., .the place that usually belongs this is...). If the participant is unable to complete the phrase, the clinician will complete it.

D. After completing all the features, the clinician requests a naming response again.

1. If correct response: verbal feedback is provided (i.e., .That's right.) and new stimulus item is presented.
2. If incorrect response: clinician provides a model of the correct response and new stimulus item is presented.