Original Article

Semantic Feature Analysis Treatment for Anomia of two nonfluent Persian-speaking aphasic patients[1]

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Objectives: Semantic Feature Analysis was designed to improve lexical retrieval of aphasic patients via activation of semantic networks of the words. In this approach, the anomic patients are cured with semantic information to assist oral naming. The purpose of this study was to examine the effects of Semantic Feature Analysis treatment on anomia of two nonfluent aphasic patients.

Methods: A single-subject study with ABA design was applied to two Persian-speaking patients with chronic nonfluent aphasia. Assessment, baseline, intervention and maintenance phases were carried out respectively during 6 weeks. A picture naming task which was made up of pictures with high name-agreement comprising 12 target, 18 non-treated control and 5 easy words was used for probes and intervention. Intervention was performed in 5 successive days, 60 minutes per session. Descriptive statistics, level, trend & slope analyses, C and d statistics were used for data analysis.

Results: Both participants revealed statistically significant improvements in naming target words. Some generalizations to control words was also occured. A minimal decrease in naming of target words was observed in maintenance phase but the naming ability was still above the baseline. The therapy maintenance effect size for both patients were obtained as medium.

Discussion: The findings of the current study seems to confirm Semantic Feature Analysis as an effective intervention for improving naming ability of Persian- speaking aphasic patients.

Keywords: aphasia, treatment, anomia, semantic feature analysis, single-subject design

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Introduction

Anomia is an eminent feature of aphasia that occurs in all types of aphasia (1,2), and usually persists into the chronic phase of the language impairment (3). Although the demonstrations of anomia is clearly evident from spontaneous speech, it is commonly evaluated by confrontation picture naming tasks (4). While naming seems an ordinary language expressive skill, its psycholinguistic nature is by no means simple. There are numerous studies regarding the underlying psycholinguistic explanation of naming. What most language production models agree on is a two-step lexical retrieval process: semantic activation level and phonological encoding (5,6). Naming process requires the activation of both semantic and phonological routes, so insufficient, imprecise, or inactivation of representation at each level or in-between mappings may result in word retrieval difficulties (7). As Wambaugh and colleagues stated, a firm specification of the disrupted lexical retrieval level in anomia is almost difficult and “the process of lexical access is interactive to such a degree that either type of treatment may benefit all levels of processing” (p.947) (8).

Here we consider Rothi’s classification of anomia treatments into restitutive and substitutive (4,9,10) as a basis for our perspective taking. In restitutive treatments the language environment of the the patient is reinforced to fascilitate the activation of semantic or phonological features of the words, in a way comparative to normal lexical retrieval procedure (4,10). Semantic Feature Analysis (SFA) method as a semantic intervention lies in the category of restitutive treatments (4) which is based on the idea of spreading activation through the semantic system (7). According to the connectionist

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models, semantic system may be considered a grid of concepts, in which a concept is made up of semantic features supplying the meaning for that concept (11). In SFA method, the patient is encouraged to produce words semantically related to the target word which is supposed to activate semantic features of the relevant semantic network (12). These activated concepts then distribute the activation throughout their related lexical entries, and eventually the activation from these lexical items spread to the associated phonological representation and activates phonological information of the target word (11). Although some studies regarding the effectiveness of SFA for oral naming of aphasic patients have been done in recent years, these studies typically investigated factors other than the issues targeted in the current study.They have rather focused on bilingualism (6,13,14), fluent aphasic patients (3,12,15), traumatic brain injuries (12,16), verb retrieval (1) or other styles of SFA intervention (such as semantic feature review (SFR) or semantic feature review and semantic feature generation (SFR+SFG) (6,7,14, 17).

Regarding the destructive effects of anomia on the patient's communicative life, the necessity of appropriate treatments effective for severity and type of aphasia is evident. Paucity of such studies in Persian language makes research indispensable to evaluate the SFA intervention effects on naming ability in Persian-speaking aphasic patients with aphasia. The purposes of this study were as follows: 1) examining the effect of SFA on anomia in two nonfluent Persian-speaking patients with aphasia, 2) evaluation of the maintenance of the effects, and 3) probing the generalization to the untreated control words.

Methods

Participants- Two patients with nonfluent acquired aphasia (both male) secondary to a left hemisphere stroke participated in the study. They were native Persian speakers, one of them was bilingual (Persian and English). The participants met the following inclusion criteria: (a) chronic nonfluent aphasia due to left hemisphere damage, (b) enough verbal output with anomia, (c) being literate, (d) being native Persian-speaker, and (e) right handedness. The exclusion criteria were as follows: (a) more than one stroke, (b) reported right hemisphere damage, (c) reported history of psychiatric or neurodegenerative disorders, and (d) hearing or visual impairments. The participants administered Persian Aphasia Test (18), Persian Aphasia Naming Test (19), Persian version of Bilingual Aphasia Test (BAT) (parts A & B), part C of Persian-English BAT (for the bilingual patient) (20), and Mini-Mental State Examination (MMSE) (21). Further, participants completed the verbal apraxia test (22) and an informal screening task of oral motor strength and function (23,24). None exhibited apraxia or dysarthria that would interfere with progress in the study.

Participant 1 (N.V.) was a 53-year-old persian-speaking male with 12 years of formal education, who was 27 months post-onset of a single, partial intracerebral and subdural hemorrhage in his left temporal lobe. Three years and seven months before Cerebrovascular accident (CVA), the subject was referred to a neurologist for frequent seizures, and a cyst in his left external capsule inside the left temporal lobe was diagnosed. After successful surgical removal of the cyst, the patient sustained a CVA. At 6 months post onset time, He did not know anyone except his family members. He had received 18 months of speech therapy as well as 40 sessions of Transcranial magnetic stimulation (TMS) before entering the SFA program. He had a right hemiplegia with recovered mild dysarthria and no verbal apraxia. His digit span was 4 and his cognitive status on Persian version of MMSE was nearly normal (score=25) at 22 months post-onset time.

Participant 2 (F.F.) was a 72-year-old bilingual Persian-English speaking highly educated male. His first language was Persian, and English as his second language was learnt naturally at youth after his migration to USA. He participated in the study at 15 months post-onset of his CVA following an ischemic infarction in his left temporoparietal lobe associated with occlusion in left ICA at petrous and supraclinoid segments. He received 20 sessions of speech/language services. Anyway, their previous speech/language therapy did not include SFA. He had recovered mild right hemiplegia and dysarthria with mild verbal apraxia, his digit span was 4 and his cognitive status on Persian version of MMSE was nearly normal (score=24) at 15 months post-onset time.

Based on test performance and clinical judgment, two participants suffered from a nonfluent aphasia with fairly well capacities in verbal auditory discrimination and auditory and reading comprehension; however, they showed some deficits in auditory and reading comprehension of slightly long, complex sentences which may be interpreted as moderate impairment of syntactic comprehension.

Both participants exhibited significant word retrieval difficulties and verbal fluency disorders. language assessments revealed him to have moderate impairment of repetition, oral reading, letter and word dictation, but he showed nearly good abilities in these tasks.

Participants' performance on naming test was reviewed to identify types of word retrieval errors as well as what cues facilitated the retrieval of words. Based on Kohn and Goodglass naming error categorization (25), N.V.'s word retrieval errors from most to least consisted of no response, semantic (inclass coordinate: e.g., "shoe" for "sock", superordinate: e.g., "fruit" for "grape", material: e.g., "cloth"for "curtain"), perseveration and circumlocution errors (e.g., for "chair" the patient said "we sit on it"); he responded to both types of cues occasionally (e.g., "to make pungent food" for pepper; /sa/ for /sandali/) to retrieve words. F.F. demonstrated mostly phonemic errors (e.g., /peltel/ for /felfel/) with a few no response, neologism (e.g., /qazxor/for/anjir/) and circumlocution errors (e.g., for "bed" the patient said "for sleeping"). He was able to retrieve some words with phonemic cues (e.g., /xa/ for /xarguš/), but not with semantic cues. Naming deficits of N.V. appeared to be due to breakdowns at the semantic processing level but in F.F. phonemic errors would indicate possible difficulties in phonological level processing (1). The ethical considerations of the present study were approved by the Ethical Board of University of Social Welfare and Rehabilitation Sciences. The participants signed a consent form stating their understanding and agreement with the terms.

Experimental stimuli and materials: A set of 299, 12×6 cm black and white line drawing picture cards of concrete and imaginable words comprising different semantic categories was examined on 40 healthy Persian-speaking men and women aged 20-70 years. They were requested to name each picture. From this set, 239 pictures with name agreement (NA) above 80% and 30 pictures with name agreement above 70% were used to obtain target, control and easy words for the study (figure 1).

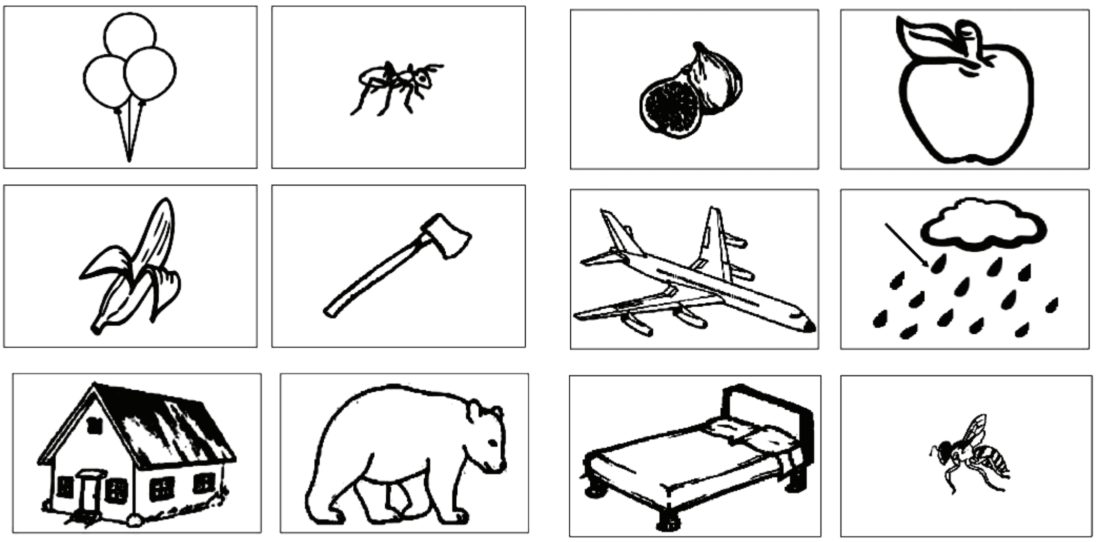

Fig 1. Some of pictures used in this study

Experimental design: applying an ABA single-subject design, baseline, probe and maintenance measures of the target (treated items) and control (untreated) words were administered to access effectiveness, generalization and maintenance of the treatment.

The patients entered *the baseline phase* for selection of target, control and easy words. This stage was accomplished during 3 sequential sessions in a week. The baselines of oral confrontation naming ability were obtained by asking the participants to name the 269 pictures, presented in random order in each session, without any cuing or feedback. The stimuli comprised target (words targeted for therapy), control (words not targeted for therapy but for examining generalization), and easy (words which were incorporated to therapy as motivating impulses) names.The target words were selected from the pictures that participants named only one time over 3 trials. Control words were selected from those pictures that participants could not name over 3 trials. Easy words included pictures that participants were able to name correctly on all 3 baseline trials. This process kept the participants motivated and willing to continue treatment. Finally 12 target, 18 control and 5 easy words were selected consisting of both high and low frequent words. The package of words were individually chosen for each patient.

The *treatment phase* was done during 5 sequential sessions in a week, 60-75 minutes per session. Patient's naming ability of target words were measured in the treatment sessions. Then in *Maintenance phase* participants completed three follow-up sessions during three weeks after intervention program to assess maintenance of naming ability for target words. All treatment sessions were performed at the participants' home to increase their willingness to participate in the study. The traditional version of SFA with 6 semantic features was used in the intervention as figure (2) (26).

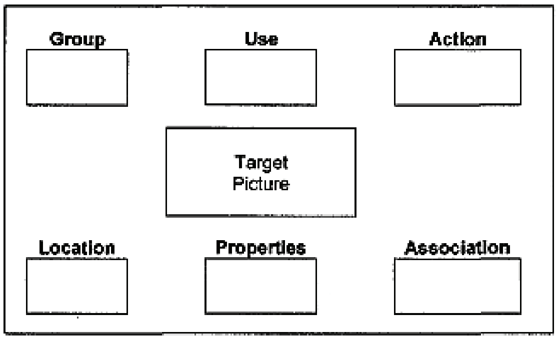

Fig 2. Semantic Eeature Analysis chart used during SFA treatment

The pictures of target words were placed on the center of SFA chart and the clinician pointed to the target picture and asked the participant to name it. Next, the clinician encouraged the patient to describe the semantic features related to the target word. Semantic features consisted of superordinate category, use, action, physical properties, location, and association. The clinician proceeded through the 6 semantic features regardless of errorful or errorless response of the patient. Of course, not every feature was appropriate for every stimulus; for example, action feature was not suitable for the target word "apple". The clinician asked the patient to describe every relevant semantic feature and wrote the participant's answer down in the corresponding box on the chart. If the participant was unable to give a correct response, or to give a response at all, the clinician provided questions, sentence-completion cues, or verbal modeling. After reviewing the whole chart, the clinician requested the participant to produce the target word once again. If the participant failed to retrieve the target word, the clinician modeled the word and asked the participant to repeat it. All the target stimuli went through the described procedures once per session. The target words were delivered randomly each session.

Scoring: During treatment sessions, a scoring sheet was used to track naming accuracy. Two separate scores were reported. The first score was related to the pictures named correctly by the participant when the stimulus was presented before implementation of the SFA, 0 for no response or an erroneous answer and 1 for a correct response. The correct name of the picture, self-corrected responses, dialectal differences or a minor error (defined as a distortion, substitution, omission or addition of one vowel or consonant) were considered correct as long as the target word was recognizable without a model or prompt. The second score was related to the accuracy of describing the semantic features, 0 for no response or an erroneous answer and 1 for a correct response. The total scores then was changed to a percent for graphical illustration.

Data Analysis: Changes from baseline to treatment phases were statistically analyzed via descriptive statistics, level, trend & slope analysis (27) and a time-series analysis using the C statistic (27-30). In addition to measuring percentage of items named correctly, effect sizes via d_2 statistic (31) were also calculated to examine durability of treatment effects during 3 weeks following treatment for treated items and generalization to untrained items. Effect sizes are interpreted following benchmarks: 4.0, 7.0, and 10.1 for small, medium, and large, respectively (32).

Results

The results of the interventions are presented in figure (3). Relatively stable baselines, defined as variations of no more than 15% across three baseline measurements, are indicated in figure (3) (33,34).

Participant (1): An initial baseline was established for him across 3 trials. He showed an improvement in his ability to name the target nouns from 58.32% to 91.67% accuracy ($C = .59$, $z = 1.90$, $p < .05$), and an upward trend with the slope of +9.327 was noted over the course of treatment for trained items, indicating good response to the training protocol. Visual analysis of level revealed that all 5 intervention-phase points were above the extended celebration line of the baseline phase indicating significant improvement during the treatment phase (figure 3).

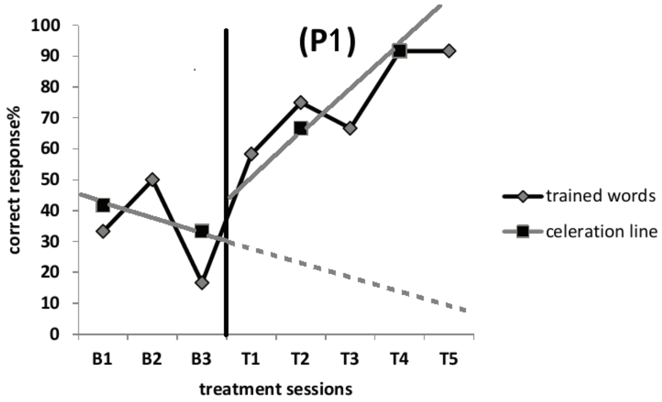

Fig 3. The celebration lines in the baseline and intervention phases for Participant one

He was able to successfully reach criterion, defined as aperformance of 80% accuracy over 2 consecutive sessions prior to completing 5 treatment trials. His accuracy declined slightly during 3 weeks following treatment from 91.67% to 83.32%; however, he maintained above baseline levels. Treatment effects yielded medium effects (d=4.62). Based on the definition of generalized improvement in naming as the ability to name at least 3 more probe items than the maximum number named during baseline sessions (3), he demonstrated generalized naming of the untreated probe nouns during the treatment condition from 0% to 27.77% (0 to 5 items) and a medium effect size was found for generalization (d=6.63). Throughout treatment, accuracy for providing information for the 6 semantic categories of 12 trained items increased from 67.19% to 82.8%, with a positive linear Trendline of 3.592 (figure 4).

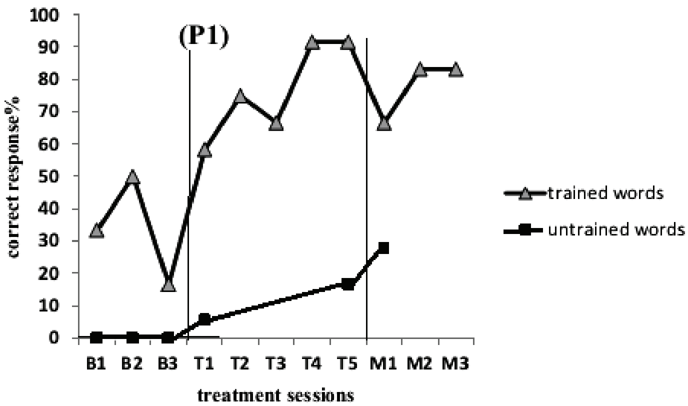

Fig 4. Naming accuracy for trained and untrained words across baseline, treatment and maintenance sessions for Participant one *(B: baseline, T: treatment, M: maintenance)*

Participant (2): An initial baseline was established for Participant one across 3 trials. Participant two's accuracy improved from 50% to 58.32% (C =.54, z =1.74, p <.05), and an upward trend with the slope of +3.473 was noted over the course of treatment for trained items, but did not perform at the criterion of 80% accuracy across 2 sessions prior to completing 5 treatment trials. Visual analysis of level revealed that all 5 intervention-phase points were above the extended celebration line of the baseline phase indicating significant improvement during the treatment phase (figure 5).

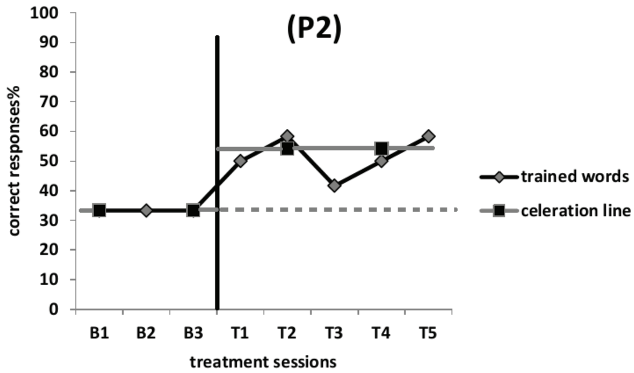

Fig 5. The celebration lines in the baseline and intervention phases for participant two

Participant two's accuracy maintained during 3 weeks after treatment at the same level of 58.32% without any decline. Treatment yielded medium effects (d=6.41). He demonstrated generalization to untreated probe nouns during the treatment condition from 0% to 22.22% (0 to 4 items) and a medium effect size was found for generalization (d=9.35). Throughout treatment, accuracy for providing information for the 6 semantic categories of 12 trained items increased from 79.7% to 88.41%, with a positive linear Trendline of 1.597 (figure 6).

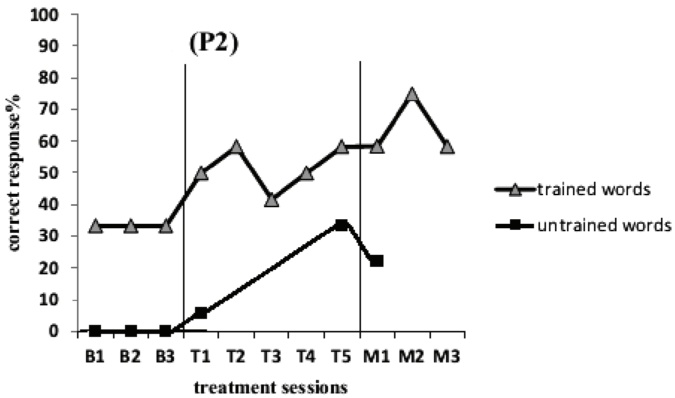

Fig 6. Naming accuracy for trained and untrained words across baseline, treatment and maintenance sessions for participant two *(B: baseline, T: treatment, M: maintenance)*

Discussion

This study aimed at investigating the effects of SFA treatment on anomia improvement of Persian-speaking nonfluent aphasic patients. Overall, the results of this study showed significant improvement in retrieval of target names which may be considered as indicating the effectiveness of SFA intervention for anomia in Persian-speaking nonfluent aphasic individuals. According to Brookshire most patients have spontaneous recovery during the first 6-months post-onset of a CVA (35). Regarding post-onset time of CVA in *participant one* and *participant two*, the participants' improvement can be attributed to the therapy and not neurological spontaneous recovery. In addition, steady baseline slope, aided in attributing the changes to the treatment.

Several research studies have demonstrated SFA effectiveness for naming improvement in aphasic patients (1,3,6,7,12-17,26,33-37), in contrast to a few cases which documented an opposite result such as in Lowell et al. study (17) which one of the 3 patients with conduction aphasia treated by SFA, did not show considerable improvement. The authors considered severe speech production deficits and substandard function on a nonverbal cognitive test of this third participant responsible of the non-improvement. The authors postulated that on one hand these deficits may have been indicative of further impairment in phonological or semantic retrieval, for which semantic activation treatment would not be effective, and on the other hand regarding the effect of cognitive functions like

attention and memory on treatment effectiveness (4,38), the ability of using semantic strategies may have been hindered by cognitive imperfections (17).
Based on recent models of naming, access to precise semantic information is an important prognosticator of word finding (15). Aphasia and other neurogenic language disorders may lead to limitations in semantic information access (39). Goodglass and Baker suggest that limitation of semantic domain of words would result in naming deficits. They assumed that successful naming is a consequence of unifying activated associations into a lexical item in semantic memory (40). As the semantic knowledge lies at the heart of picture naming, the necessity of developing well-organized naming treatment methods concentrating on semantic representations seems clear. SFA technique aims at facilitating picture naming by focusing on the semantic features of the target word (7). Evidence shows that in SFA approach, semantic feature description would enhance lexical activation which may improve confrontation naming person (3). The participants in this study appeared to experience breakdowns at different levels of the lexical accessing process. Some cognitive neuropsychological models of lexical processing would characterize *participant one's* performance as indicative of a deficit in semantic processing and *participant two's* performance as indicative of impaired phonological processing. Despite these apparent differences, both participants benefited from a semantic treatment. This finding may be consistent with the notions that SFA can be successful in improving lexical processing for more than one level of impairment (3), may be effective for aphasic participants with partly intact semantic knowledge but damaged word-retrieval abilities, and can be used for a wide range of neurogenic patients (36). Although based on the current and previous studies, SFA treatment is effective for individuals with different mechanisms of anomia, it is probably more effective for participants with anomia due to impairments in semantic processing, a consideration which is somewhat reflected in the greater effect of SFA for *participant one* than *participant two* which is compatible with their probable underlying processing impairments.
An fMRI study revealed that dynamic changes in the level of integration within and between the networks during SFA therapy is the main cause of naming improvement (41). This finding may lead us to conclude that word retrieval improvements following SFA may be attributed to the reinforcing the links between the intended word and its semantic domain (34). In this study SFA method resulted in untreated control words improvement that is compatible with the results of previous studies about SFA efficacy in treating control words (3,7,12,16, 17,26,33,35-37). Various studies demonstrated that even training a few words in SFA prompts untreated control words improvement (3,12,26). The finding of response generalization to untrained items might suggest that both patients were developing a retrieval strategy for easier access to the semantic system in general, regardless of specific targeted semantic categories (3,42). Another possible explanation for response generalization in SFA is common semantic category in trained and untrained items resulting in stimulation of the shared semantic network (1,3), although in this study only 50% of untrained stimuli belong to the same semantic categories as trained items, but patients showed recovery in both treated and novel categories.
Although *participant one's* performance decreased minimally during maintenance yet remained above baseline levels and *participant two* maintained his performance at the same level of the last treatment session that are compatible with the results of previous investigations (1,3,7,12,15-17,26,34-36,42). There are some facts that might explain why SFA has a durable effect. In SFA approach, on one hand the subject tries to give semantic information about the target, and on the other hand frequent use of the visual SFA chart with written reminders of the features might interiorize the chart and enables the subject to self-cue in the absence of the chart (26). The results of the current study indicated that both the patients' ability of semantic features generation, and their naming ability of treated words improved through treatment sessions, a finding that is compatible with Jarvis study (35). As noted earlier, frequent retrieval of multiple semantic features of a lexical item in the SFA intervention (16) seemingly facilitate the selection of important features sufficient for activation of relevant semantic representations, associated lemma and phonological word respectively. Repeated use of SFA chart for a word may lead to activation of its related repesentstions at different processing levels. This regular activation could help to strengthen the links between semantic representations and lemmas and thus improve oral naming (3). Beside the application of SFA for word form retrieval, reviewing the features can be applied as a compensatory retrieval strategy (1).
In spite of clear advantages of SFA shown in the current study, the limitations of the study makes the

generalization of the results difficult. Limitations in the number of participants, low datapoints of baseline, treatment and follow up sessions, and heterogeneity of participants' language profiles are among the most important limitations. SFA seems a fruitful tool to be used as part of a therapy program for dealing with anomia due to its capacity to activate information in the semantic network and vectoring phonological word access. Initial SFA treatment sessions take a longer time to allow the participant to identify each category, understand and apply the concepts (the parts which are especially difficult for some patients), so it is suggested that fewer words be used throughout the therapy sessions (7). Future SFA studies should focus on whether it is the number or types of features used, aphasia severity, or length of treatment that are critical factors in rehabilitating naming deficits in aphasia. Also, there is a need to investigate the effect of SFA on anomia of different kinds of aphasia based on their underlying impairement mechanisms. Semantic Feature Analysis therapy may be better understood if a larger group of patients in multiple baseline design be recruited in future studies.

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