ABSTRACT: Semantic feature analysis (SFA) is a therapeutic technique that is used for the treatment of naming deficits occurring with aphasia. Aphasia commonly impairs a person’s ability to retrieve words easily, and speech-language pathologists (SLPs) often struggle to determine an effective means of facilitating this skill. SFA has been shown to improve naming of targeted items with generalization to control stimuli. SFA also teaches the individual with aphasia a process for accessing semantic networks and for self-cueing. This project examined the use of SFA to address naming deficits and measured the impact of SFA on connected speech output with an individual with moderate aphasia with both expressive and receptive components. The study was conducted in two phases: The first stage examined improvements in naming skills, and the second stage assessed improvements in connected speech. This individual demonstrated improvements in naming for trained and untrained stimuli and also increased in measures of connected speech from baseline over a 17-month period. The usefulness of SFA for practicing SLPs in the current health care service delivery system is discussed.

KEY WORDS: aphasia, anomia, semantic feature analysis, naming, mapping

Aphasia can affect any aspect of language and frequently impairs the ability to produce a desired target word, generate sentences, transform thoughts into words, and name people and things. The deficits in naming can be especially frustrating to the individual and to his or her communication partners. Naming deficits are common in aphasia regardless of subtype, and semantically based errors are frequent (Ardila & Roselli, 1993; Drew & Thompson, 1999; Hillis, 1989; Kohn & Goodglass, 1985). Individuals with aphasia must be able to access their stored vocabulary in order to combine words and produce longer utterances for functional communication such as requests, comments, and questions. The inability to retrieve specific words leads to vague and ineffective communication.

Naming abilities are frequently addressed in treatment by speech-language pathologists (SLPs) and may be a main focus of therapy if deficits are prominent. Retraining the names of all of the objects and people in an individual’s personal lexicon is not an effective or efficient therapy technique, and generalization for confrontation naming tasks is often limited (Nickels, 2002). Therefore, SLPs have sought a method of treating naming deficits in which the process of retrieving specific words and words related to the target word is improved.

Most of the research data on the treatment of naming deficits has been drawn from single case studies. Treatment approaches typically focus on improving semantic processing or phonological access skills depending on the individual’s underlying deficit area. Hillis (1989) addressed written naming skills in 2 individuals with aphasia by requiring them to write the names of pictures using a written cueing hierarchy. In 1990, Hillis expanded on this approach, providing feedback to incorrect naming responses by drawing the incorrect object and contrasting it to the target. Naming skills improved, and generalization to semantically related items was demonstrated. A variety of other semantic processing tasks have been used to improve picture naming skills. These tasks include auditory word-to-picture matching, written word-to-picture matching, and answering yes–no questions about the target (Hillis, 1989; Howard, Patterson, Franklin, Orchard-Lisle, & Morton, 1985a, 1985b). Researchers have also used forced-choice
questions about pictures and repetition of the target name as part of naming therapy (Nickels & Best, 1996). Nickels and Best (1996) discussed a study by Jones (1989) in which an individual was asked to judge relationships of target pictures to related and unrelated pictures. The individual with aphasia was then given the letters of the target in scrambled format and asked to reassemble and verbalize the word, thus providing a mix of semantic and phonological cues. Improved naming for treated and untreated items was noted after 10 weeks of therapy, and errors changed in nature from no response or neologism to phonologically related errors. Pring, Whitt-Thomson, Pound, Marshall, and Davis (1990) used written word-to-picture matching in a field of semantically related and unrelated choices. Participants read the words aloud before naming the picture in order to provide phonological as well as semantic input. Improvements in naming were noted on treated items and semantically related foils. Improvements were maintained at 1 month for all participants and at 1 year for 6 of the 7 participants. Martin, Fink, and Laine (2004) used repetition priming with spoken word-to-picture matching, repetition, and naming tasks to address picture naming and found that progress varied for individuals depending on whether the underlying deficit was semantically or phonologically based.

Previous studies (Boyle & Coelho, 1995; Coelho, McHugh, & Boyle, 2000; Lowell, Beeson, & Holland, 1995; Massaro & Tompkins, 1992) have demonstrated success in treating naming deficits using semantic feature analysis (SFA). SFA is based on the theory that neural connections between related concepts are strengthened within the semantic system so that access to vocabulary becomes more automatic. By generating words and phrases that are related to the target and activating the entire surrounding semantic network, the target is more likely to be accessed and produced. SFA also 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 SLP. Providing multiple forms of input for cueing may be more facilitatory than phonologic or semantic cues in isolation (Hillis, 1989; LeDorze, Boulay, Gaudreau, & Brassard, 1994; Martin et al., 2004; Nickels & Best, 1996; Pring et al., 1990).

In the process of SFA, the individual is asked to name a common picture. In this study and in previous studies, picture stimuli have included only nouns as these lend themselves to description through the mapping process most easily. If the individual cannot name the picture, the SLP provides assistance in answering a set of description and function questions about the target by writing and verbalizing responses. A mapping form with sample questions listed on it is used for this process. All questions on the map are completed, in no particular order. This process provides both visual and auditory 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 individual repeats it.

The individual is trained to name a set of common pictures, and probes are conducted periodically to assess generalization to untrained pictures. Prior studies with individuals with a cerebrovascular accident (CVA) (Boyle & Coelho, 1995) and traumatic brain injury (Masarro & Tompkins, 1992) demonstrated generalization to untrained pictures, retention of naming ability of the trained stimuli, and variable increases in measures of connected speech. The degree of success with this technique may be related to the severity and type of aphasia.

The purpose of this study was to determine the effectiveness of the SFA technique with an individual with aphasia after CVA. This individual demonstrated expressive output at the phrase and short sentence level and produced semantically based word substitutions. A cause of naming deficits in fluent aphasia is thought to be a deficit in the semantic processing system (Shelton & Caramazza, 1999); thus, a treatment targeted toward facilitating semantic activation was chosen for use with this individual. Semantically based treatment emphasizing semantic relationships often improves processing and naming (Kiran & Thompson, 2003). Research questions to be answered were whether SFA was a practical therapeutic intervention in a clinical setting using commercially available materials, whether naming gains would be noted using several sets of picture stimuli, whether gains in naming skills would generalize to measures of spontaneous speech, if treatment gains in naming could be maintained long term, and whether strategies used in the mapping process would be generalized to use in other communication situations.

### METHOD

#### Participant

The participant in this case study (J.S.) was a 59-year-old, left-handed, native English-speaking female who was 4 months post onset of a left-hemisphere ischemic CVA. Magnetic resonance imaging 1 day after hospitalization revealed an acute infarction affecting the left temporal and parietal lobes and the left basal ganglia. J.S. was hospitalized for 4 days after the CVA and received physical therapy in the hospital followed by 6 weeks of speech therapy and occupational therapy in the home. J.S. was able to ambulate independently after she returned home, and the only residual physical problem reported was mild weakness in the right arm. J.S. sought speech therapy at the university speech and hearing clinic because she had reached the maximum therapy benefit with her insurance.

J.S. had a bachelor’s degree and some graduate coursework. She was employed as a bookkeeper before the CVA and was married and living with her spouse during the research project. She was independent in activities of daily living when she began therapy at the clinic but required some assistance with language-based activities such as using the telephone, writing lists, and paying bills. Hearing and vision skills were within functional limits for independent living, and no motor speech disorder was present. J.S. could follow multiple stage directions, comprehend information from the television, and participate in group conversations with minimal difficulty. Expressive communication skills were reported to be the main residual area of
deficit. Prominent word retrieval deficits and syntax errors with reduced sentence length and slow sentence formulation characterized her spontaneous speech. The most frequent error in word retrieval was an inability to generate a name for objects. When J.S. produced word substitutions, they were semantic in nature, which was one reason for using the SFA protocol.

**Procedures**

J.S. was seen for speech therapy twice weekly for 1 hr during which the SFA protocol was used. Sessions continued for 6 weeks, and follow-up testing occurred at 6 weeks, 12 weeks, 18 weeks, and 1 year after the project ended to determine if and how gains in naming were maintained. J.S. did not receive speech therapy from any other source during the study. Other areas targeted in the individual sessions at the clinic were auditory comprehension (e.g., describing video clips), reading comprehension (e.g., answering questions after reading multiple paragraph length text), and writing (e.g., generating words and sentences about a topic or picture). SFA was the only treatment used to target verbal expression.

**Baseline assessment.** At the baseline evaluation, J.S. was administered the Aphasia Diagnostic Profiles (ADP; Helm-Estabrooks, 1992), which revealed an aphasia profile of borderline fluent aphasia with decreased phrase length and deficits in repetition and auditory comprehension skills. Auditory comprehension deficits did not prevent use of the SFA protocol. J.S. scored an aphasia severity composite (standard) score of 102 ($M = 100; SD = 15$) on the ADP as compared to other individuals with aphasia. Individuals without aphasia should score at the maximum score of 130. It should be noted that this test may underestimate the degree of aphasia present because nonaphasic individuals are not included in the normative sample. The ADP was used to determine a baseline level of aphasia severity and to monitor change over time. Additionally, this test was chosen because it is commonly used by practicing SLPs in medical settings due to its ease of use and brevity. The Boston Naming Test (BNT; Kaplan, Goodglass, Weintraub, 1983) was administered as an additional assessment of confrontation naming skills. J.S. scored 51.6% (31/60) on the BNT, and errors were either no response or a semantic substitution error. The Social Communication Scale of the American Speech-Language-Hearing Association Functional Assessment of Communication Skills for Adults (ASHA FACS; ASHA, 1995) was completed by J.S.’s spouse at the beginning and end of the project to assess functional communication skills in the home setting.

To determine baseline naming skills on the picture stimuli, J.S. was asked to name a set of 211 functional pictures each session over three treatment sessions. J.S. attempted to name all 211 pictures each session and participated in this task without signs of fatigue. The target and control picture sets for the SFA protocol were chosen from this set of pictures. The picture stimuli used were actual photographs of common household items taken from “More Photo Cue Cards” (Kerr, 1979). These were used instead of the black line drawings used in other studies because the photo cards are more realistic representations of functional objects and are easier for older adults to visualize. Providing redundancy in stimuli such as using actual objects or photographs rather than drawings has been found to improve naming skills (Benton, Smith, & Lang, 1972; Bisiach, 1966). These picture cue cards are also commercially available and readily accessible to practicing SLPs.

Target and control picture sets were identified during the initial baseline assessment phase with the standard protocol used in prior SFA studies. Pictures that J.S. named correctly in one of three attempts were placed into the sets to be trained. These trained picture sets were the stimuli used in each treatment session to track naming accuracy. Those pictures that J.S. was able to name in three of three attempts were identified as easy pictures and were rotated into the daily sets periodically for success and reinforcement with the task. Ten pictures that J.S. was unable to name on any of the three attempts were randomly chosen and placed into the untrained/control set.

**SFA treatment sessions.** The trained picture sets consisted of three sets of 10 cards and one set of 7 cards. J.S. was asked to name each picture, and the mapping process using an SFA diagram (see Figure 1) (Haarbauer-Krupa, Moser, Smith, Sullivan, & Szekeres, 1985; Massaro & Tompkins, 1992) was initiated even if she was able to spontaneously name the picture. A response was only judged as correct if the picture was named spontaneously without any prompts. Phonemic paraphasias were not accepted as correct. 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. When possible, J.S. wrote the semantic features on the chart after verbalizing them. If she was unable to write the feature, then the SLP wrote the words. If J.S. was unable to provide an answer to each of the prompts, then it was provided verbally by the SLP and was also written on the map. After the entire map was completed, J.S. was again asked to name the target picture. If she was still unable to do so, then the response was provided verbally by the SLP and J.S. was required to repeat it. Criterion for mastery of the four sets of picture cards was 80% for spontaneous naming of each set. One set was completed each session, and the sets were rotated until the 80% criterion level was reached on each set.

**Assessment of Naming Skills**

Naming probes with the untrained pictures were conducted every fourth treatment session to determine generalization of naming skills. Follow-up assessments after the cessation of the SFA treatment protocol were also conducted at 6 weeks, 12 weeks, 18 weeks, and 1 year (17 months after initiation of the study). During these probes, J.S. was presented with the trained picture sets and the untrained picture sets and was asked to name them using the SFA technique. No verbal or visual prompts were provided, and it was assumed that the SFA diagram was internalized at this point. During this time period, J.S. continued to receive speech therapy targeting skills that were addressed during the SFA project. These included writing to dictation,
writing at sentence level given verbal or picture stimuli, and verbally describing tasks using video clips and hypothetical scenarios as stimuli. Naming skills were not targeted directly using SFA or any other approach.

**RESULTS**

**Progress in Naming Skills in Treatment Sessions**

The initial baseline for the 211 pictures was 32%, or 68/211. Criterion of 80% for each of the four sets of trained pictures was reached after 11 sessions (see Figure 2). Note in Figure 2 that as the new set of trained pictures was rotated into the sessions, accuracy fell until criterion was again reached. Naming probes of untrained pictures were conducted every fourth treatment session, as seen in Figure 3. Accuracy levels for these untrained pictures increased from 0% to 50%. Testing of the trained picture sets after the treatment protocol ended indicated that treatment effects were maintained at 6 weeks (81%), 12 weeks (86%), 18 weeks (89%), and 1 year (90%) (see Figure 4). J.S. appeared to be using the mapping technique aloud to facilitate naming of stimuli during the probe sessions and in spontaneous speech and became faster in the naming tasks over the course of the study.

**Generalization to Untrained Pictures**

The untrained or control stimuli were chosen from the baseline testing from the pictures that J.S. was unable to name on any presentation. She scored the following accuracy levels on naming these pictures at the various posttest time points: 6 weeks (80%), 12 weeks (90%), 18 weeks (90%), 1 year (90%) (see Figure 4).

**Assessment of Connected Speech**

Another aspect of this study was to determine whether gains in naming from the SFA protocol would improve connected speech measures; how long these gains, if any, would be maintained; and whether connected speech would continue to improve over time. Information about generalization of naming skills to spontaneous speech was gathered in testing at 12 weeks, 18 weeks, 24 weeks, and 30 weeks following the end of the SFA protocol. Six connected speech samples were obtained during each assessment, including a request for personal information (e.g., “What do you do on Sunday?” “Where do you live?” “Tell me about your family.”); picture sequence (e.g., birthday cake picture scene, farmer giving directions sequence [Nicholas & Brookshire, 1993]); picture description (e.g., cookie theft picture from the Boston Diagnostic Aphasia Examination [BDAE; Goodglass & Kaplan, 1983], grocery store picture from the ADP [Helm-Estabrooks, 1992]); stuck in a tree
scene (Nicholas & Brookshire, 1993); and a request for procedural information (e.g., “How do you make a sandwich?” “How do you wash dishes?” “How do you write and send a letter?”). There were no time constraints on this task, and J.S. was prompted verbally with nonspecific cues (“Can you tell me more?”) no more than one to two times per sample if needed. Two sets of stimuli were used, and these were alternated between assessment sessions.

Reliability and data analyses. The connected speech samples were audio-recorded, transcribed verbatim, and analyzed. The graduate student clinician and one of the two ASHA-certified co-investigators scored all of the samples from the recordings independently. Any scoring differences were resolved through discussion between the co-investigators until consensus was reached. Analyses of the connected speech samples were conducted using Nicholas and Brookshire’s (1993) rules for scoring and counting words and correct information units (CIUs). CIU analysis is a standardized, rule-based scoring system that is designed to evaluate the informativeness and efficiency of connected

Figure 2. Naming ability on trained stimuli during each treatment session.

Figure 3. Probes of untrained pictures during the treatment period.
Figure 4. Naming ability on trained and untrained stimuli on posttests.

speech. Individuals without aphasia produce more words, CIUs, words per minute, and CIUs per minute than do persons with aphasia. To be counted as CIUs, words must be accurate, relevant, and informative, relating to the stimuli, but words do not have to be used grammatically (Nicholas & Brookshire, 1993). Total words, CIUs, time, words per minute, and CIUs per minute were calculated for the connected speech samples.

Data collection. Response recording was conducted by the graduate student clinician during the session, and one of the co-investigators also response-recorded each session from an observation room to ensure that scoring was reliable. The probes for CIUs and generalization to untrained pictures were scored by the clinician and a co-investigator. When questions arose regarding acceptable scoring differences or naming substitutions (i.e., possible synonyms), consensus was obtained through discussion.

Results of Connected Speech Measures

As shown in Figure 5, J.S. demonstrated moderate improvements in CIUs per minute and words per minute, and these improvements continued up to 18 weeks after SFA treatment was discontinued. These measures indicate that J.S. was able to verbalize information more quickly and with more substantive content in confrontation and in narrative tasks.

Social Communication Skills

Improvements were noted in most areas of social communication on the ASHA FACS, although these should be interpreted cautiously as there are many uncontrolled variables that may account for these changes. This scale ranges in scores from 1 to 7, with 1 being inability to complete a task with any level of assistance and 7 being independent. J.S. progressed from requiring at least moderate assistance (score of 5) in 6 out of 28 areas to requiring moderate assistance in only one area (explaining how to do something). Areas of improvement included using the names of familiar people, conversing in noisy situations, understanding figurative language, understanding the television, and recognizing and self-correcting communication errors. These changes reflect improvements in functional communication skills that occurred over time and may or may not be related to the SFA technique.

Follow-up Testing

Seventeen months after the initial baseline assessment. J.S. attained an aphasia severity composite score of 123 on the ADP, which was 21 points higher than her score at the initial testing. Her aphasia profile at the conclusion of the study as described by the ADP was fluent aphasia with conduction and anomic characteristics. Lexical retrieval scores on the ADP increased from an initial standard score of 11 to a score of 15 ($M = 10$, $SD = 3$). This score is derived from naming common pictures, using CIUs in connected speech, and answering personal information questions. The BNT was also readministered at the follow-up evaluation as an additional assessment of confrontation naming skills. J.S. scored 1 $SD$ below the mean (81.6%), indicating that she was in the low average range on confrontation naming. This score on the BNT was similar to her last score on naming the untrained pictures.
DISCUSSION

The participant in this case study demonstrated generalization and maintenance of naming skills to untrained items over a 17-month time period. Improvements in connected speech were also noted. J.S. was able to produce more words per minute and CIUs per minute, making her expressive language more robust. She became faster with using the mapping technique, requiring approximately one third of the time she initially needed. As the training progressed, J.S. appeared to become more confident and independent with mapping and was observed to automatically self-cue using the technique. An example of this self-cueing was noted on the untrained item “kitty litter.” J.S. spontaneously verbalized, “It’s an ingredient. It’s cat. It’s kitty litter.” Another example involved a picture of a fortune cookie. J.S. verbalized, “Cookies in a restaurant, Chinese, Japanese, fortune cookie.”

This study contributes support to the use of SFA as a functional therapeutic means of facilitating naming and connected speech. It should be noted in interpreting these results that spontaneous recovery may have played a role in the improvements that were noted. However, speech therapy is not withheld during spontaneous recovery, and SLPs should use functional treatment approaches. SFA emphasizes semantic processing and self-cueing for naming skills that are applicable in any communication situation. It should be considered that the other therapy activities addressing auditory comprehension, reading, and writing may have affected the improvement in naming skills. The extent to which this may have occurred cannot be determined because these activities were conducted concurrently with the SFA treatment.

J.S. is typical of patients who SLPs encounter in rehabilitation settings. Many individuals are 3 months or more post onset of aphasia and have used all of their insurance benefits for therapy but still demonstrate a significant need for services. Because many individuals have few financial resources and accountability standards for SLPs are high, therapy techniques that are results oriented and functional are crucial. SFA is an easily replicated technique that can be used in a variety of inpatient and outpatient settings. The color photographs used in this study are functional and are commercially available. The cost of implementing the technique is minimal, and family and caregivers can easily learn the mapping process. Involving caregivers in therapy improves the likelihood of carryover of the mapping technique and provides a way to cue the person with aphasia and decrease frustration in the communication exchange. The length of treatment time used for this study was fairly brief and was within the timeframe that many payors allow for speech therapy when benefits are available. This technique teaches individuals a process of thinking and generating language using a purposeful, step-by-step format similar to what they may have used before acquiring aphasia.

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Contact author: Lori A. Davis, EdD, CCC-SLP, Assistant Professor, Department of Communication Disorders, University of Tulsa, 600 South College, Tulsa, OK 74104. E-mail: lori-davis@utulsa.edu