Semantic Feature Analysis and Self-Cueing Strategies in Aphasia

By

Kelly Zarifa
M.A., Speech-Language Pathology, University of Kansas, 2011
B.A., Communication Sciences and Disorders, Wichita State University, 2009

Submitted to the graduate degree program in Speech-Language-Hearing and the Graduate Faculty of the University of Kansas in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Co-Chair: Susan Jackson, Ph.D., CCC-SLP

Co-Chair: Nancy Brady, Ph.D., CCC-SLP

Holly Storkel, Ph.D., CCC-SLP

Gail Pashek, Ph.D., CCC-SLP

David Ekerdt, Ph.D.

Date Defended: 15 July 2021

The dissertation committee for Kelly Zarifa certifies that this is the approved version of the following dissertation:

Semantic Feature Analysis and Self-Cueing Strategies in Aphasia

Co-Chair: Susan Jackson, Ph.D., CCC-SLP

Co-Chair: Nancy Brady, Ph.D., CCC-SLP

Date Approved: 15 July 2021

Abstract

Purpose: Semantic Feature Analysis (SFA) has proven to be successful in facilitating naming of trained words in persons with aphasia and is grounded in current theories of word retrieval. Briefly, traditional Semantic Feature Analysis charts for use with persons with aphasia include six boxes, each labeled with a semantic feature surrounding a picture of a target word. The major shortcoming of traditional Semantic Feature Analysis treatments is little generalization from treated words to untreated words. One avenue for optimizing the use of SFA for treatment of word retrieval deficits in this population is to provide the person with aphasia with a strategy for self-cueing of the semantic features. This study seeks to optimize an SFA-based intervention through the use of a color- and symbol-coded strand of beads (the Expanding Expression Tool, EET) to increase generalization of word-finding abilities to untrained words during one-on-one treatment delivered remotely.

Methods: Three persons with chronic aphasia secondary to left-hemisphere stroke participated in SFA intervention sessions using the Expanding Expression Tool. All supplies were delivered to the homes of the participants via no-contact drop offs, and the participants took part in the sessions from their homes via their own electronic devices. The sessions took place over password-protected, secured telehealth Zoom lines. Family members/caregivers assisted with initial set-up as needed, and administration of assessments. During the intervention, participants were asked to name pictured nouns that were screen-shared, and SFA intervention was implemented along with the physical manipulation of beads on the EET strand as the picture was described, with examiner-provided cues to describe the semantic feature as needed. Finally, the participant was given another opportunity to name the item; failure to name the pictured noun was followed by a phonemic cue from the examiner. If the phonemic cue failed to elicit the target word, the examiner provided the target word, and the participant repeated it. Five target words were treated in each session, and treated and untreated words were probed at the end of each session in random order. Ten words in each of four semantic categories were chosen for each participant, with words in three of those categories receiving treatment. Follow-up probes were taken at two and six weeks post-treatment.

Results: Remotely-delivered training in Semantic Feature Analysis using the Expanding Expression Tool (EET) resulted in an increase in naming treated pictured nouns for all three participants. Naming untreated words in the same semantic category as the treated words increased for one of three categories for Participant 1, showed a slight increase in overall average in all three categories for Participant 2, and did not increase for Participant 3. Naming untreated words in a different semantic category mostly did not increase from baseline. Naming of treated nouns at the two- and six-week follow-up probes was at or well above scores at baseline in all instances except for one participant in two categories, but follow-up naming scores were typically slightly below those attained at the conclusion of intervention. Scores on a standardized measure of naming (the BNT-2) also increased slightly during post-testing.

Conclusions: Overall findings support that EET may show promise as a supplement to traditional SFA to serve as a self-cueing strategy to increase word-finding for persons with aphasia. While generalization of results to untrained stimuli remained limited in this study, further research is warranted to develop a systematic approach to instructing the use of the EET and delivering the intervention to a more diverse population of persons with aphasia. Results also demonstrate that Semantic Feature Analysis modified for use with EET can be successfully implemented as a remote intervention for persons with aphasia.

Acknowledgments

I would like to thank Dr. Susan Jackson for her mentorship throughout my doctoral program and continued support as emeritus faculty. I would also like to thank Dr. Nancy Brady for her guidance and for stepping in as my co-chair as well as her advisees for their encouragement during our meetings. Thank you to the additional members of my committee, Dr. Ekerdt, Dr. Pashek, and Dr. Storkel for their feedback and guidance throughout my doctoral pursuits. Thank you to the participants who made this research possible, as well as to their family members and caregivers for their support. Thank you to those who worked “behind the scenes” assisting with technology, and the staff in the Hearing and Speech Department. Finally, I would like to thank my friends and family who have encouraged and supported me from near and far. This work was supported in part by the Lee Silverman Voice Treatment (LSVT) Global Student Small Grant.

Table of Contents

List of Figures

List of Tables

Chapter 1: Introduction

The most ubiquitous language disability resulting from stroke involves finding the right word at the right time. When word-finding deficits are mild, they make communication difficult. When they are severe, they can render communication difficult and frustrating, if at all possible. One common way of facilitating word recall is to direct the stroke survivor's attention to target words by activating concepts that are semantically related.

It is estimated that over two million people in the United States today are living with aphasia, and there are an estimated 90,000 new cases of aphasia each year (National Aphasia Association, n.d.). Though aphasia does not directly affect intelligence, it does impair one's ability to speak and understand others and can have life-long implications. Persons with aphasia exhibit different types of language disorders, which may include impairment in oral expressive language, auditory comprehension, reading, and writing. Although these language deficits can vary in type and severity, word retrieval deficits are a hallmark of aphasia and are present across all aphasia types and severity levels (Goodglass, 1980; Nickels, 2002).

At a minimum, word retrieval includes the cognitive processes of activating in the brain the properties of the item (semantic processing), retrieval of the word (phonological processing), and articulation of the retrieved word (Laine & Martin, 1996). Aphasia may cause a breakdown in any of these processes, making word retrieval difficult for the person with aphasia (Dell & O'Seaghdha, 1992). Thus, interventions that strengthen activation of the semantic network in persons with aphasia can lead to stronger word retrieval abilities.

One of the most well-researched ways of facilitating word recall in persons with aphasia is to develop and learn to activate one's semantic network. Semantic feature analysis, or SFA, is the most notable intervention technique used for this purpose. SFA treatment typically involves using a chart to support individuals with lexical retrieval difficulties as they generate features of a target concept – such as the group to which the item belongs, or where the item is typically found (Figure 1)(Boyle, 2010). With few exceptions, however, semantic feature analysis has not consistently enhanced naming of words unless they are explicitly practiced in therapy, and it has not typically led to generalized naming skill or to improved naming abilities in meaningful communication contexts (Nickels, 2002; Wisenburn & Mahoney, 2009). Thus, the intervention technique that has been most thoroughly studied and that is well-suited to address the most common language symptom of stroke survivors with aphasia has significant limitations as a practical language intervention strategy.

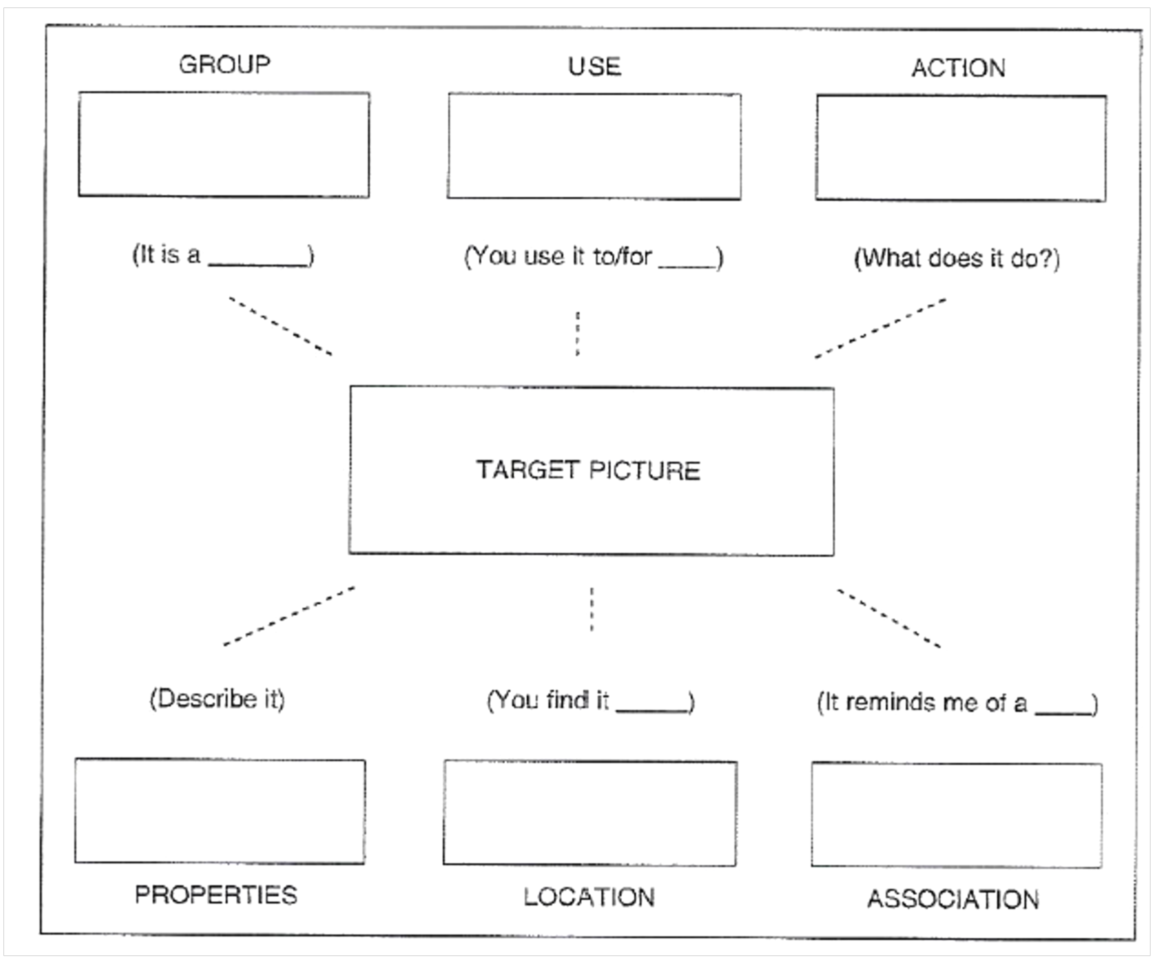


Figure 1: Semantic feature analysis (SFA) chart used during traditional SFA treatment

There have been numerous modifications to “traditional” semantic feature analysis treatment in the past. Some clinicians have modified the original SFA chart proposed by Boyle to increase or reduce the number of categories to individualize treatment for their clients for example. In some studies, researchers have used verbs as word retrieval targets rather than nouns (Wambaugh & Ferguson, 2007; Wambaugh, Mauszycki, & Wright, 2014). In a few SFA- based studies, researchers have gone beyond the impairment, single-word level to target the discourse level (Antonucci, 2009; Falconer & Antonucci, 2012; Peach & Reuter, 2010). It is of note, however, that in these and other past SFA studies, there was either little generalization to untreated words or beyond the word level, or little information regarding generalization of word retrieval abilities.

To date, interventions employing Semantic Feature Analysis have proven to be successful in facilitating word retrieval in persons with aphasia for target words but show little generalization of learned skills to untreated words within a semantic category, to untreated words across semantic categories, and beyond the word level to the picture description or discourse levels. In other words, SFA is useful in improving confrontation naming abilities, but fails to reach beyond the impairment level to the activity/participation level. This results in limited functional impact on the person’s quality of life and lack of improvement at the conversational level in natural environments.

One avenue for optimizing the use of Semantic Feature Analysis for treatment of word retrieval deficits in this population, is to provide the person with aphasia with a strategy for self-cueing of the semantic features that can be implemented independently. Use of a portable, color-coded strand of beads representing each of the semantic features to teach semantic self-cueing explicitly throughout the therapy process could lead to better generalization of SFA strategies.

This modification to traditional SFA could promote word retrieval beyond treated words – a factor that is critical in the promotion of communicative independence for this population.

Chapter 2: Literature Review

Stroke and Aphasia

Aphasia is an acquired language disorder that can affect both comprehension and production of language. Although the etiology of aphasia can vary and can include head trauma (i.e., blunt force trauma to the head, gunshot wound etc.), infection, or even brain tumor to the portions of the brain responsible for language, the most common cause of aphasia is stroke (National Aphasia Association, n.d.; NIDCD, n.d.).

Strokes can be either hemorrhagic or ischemic in nature. Hemorrhagic strokes occur when a blood vessel in the brain leaks or bursts. When the blood leaks into surrounding brain tissue, it is called an intracerebral hemorrhage; when the blood leaks into the area between the brain and the arachnoid meningeal layer, it is called a subarachnoid hemorrhage (American Stroke Association, n.d.). According to the American Stroke Association, hemorrhagic strokes account for only 15 percent of strokes, but they cause approximately 40% of stroke deaths (American Stroke Association, n.d.).

The more common form of stroke is the ischemic stroke. This type of stroke occurs when there is a blockage preventing blood from being carried to the brain. Ischemic strokes can be either embolic or thrombotic. In an embolic stroke, a blood clot is formed somewhere in the body and travels to the brain, blocking the flow of blood and resulting in stroke. In a thrombotic event, a blood clot forms inside an artery that supplies blood to the brain (National Stroke Association, 2019).

Although stroke is largely preventable, it is the fifth leading cause of death in the United States (CDC, n.d.) and a leading cause of adult disability. When a stroke causes insult to one or more of the language areas of the brain (typically in the left hemisphere), it may result in aphasia.

Aphasia can be classified into different types or categories depending on the characteristics exhibited. Two broad categories that are often used to classify aphasia are fluent and non-fluent. Fluent aphasias include: Wernicke's, Transcortical Sensory, Conduction, and Anomic. Non-fluent aphasias include: Global, Broca's, Isolation, and Transcortical Motor. Aphasia can be classified into these different types based on the qualities of language exhibited (ability to repeat information, comprehend, fluency of speech, and word-finding ability). Within each of these classifications of aphasia, there can be a range of severity level. Aphasia can make communication slightly frustrating in mild cases, whereas it can render traditional communication near impossible and be entirely life-altering in others.

Aphasia can have an impact on all forms of language including spoken language, written language, auditory comprehension, and reading comprehension. One aspect of language that is common in aphasia even in its most mild form is deficits in word-finding. This persistent difficulty with finding the right word at the right time can cause extreme frustration both for the communicator and for the communication partner. Since word-finding deficits are a ubiquitous trait among all types and severity levels of aphasia to at least some degree, considerable research has been done in the area of word-finding in aphasia.

Semantic Feature Analysis (SFA)

Introduction

Semantic Feature Analysis is a well-documented technique, which involves use of a schematic to describe the semantic features of a target item. Briefly, the technique is designed to activate and strengthen impaired semantic neural networks surrounding target items, thereby improving lexical retrieval of the target item (Boyle, 2004).

History of Semantic Feature Analysis (SFA)

Although now widely used in the treatment of word retrieval deficits in persons with aphasia, Semantic Feature Analysis was originally designed for use in organizing thought processes in populations with traumatic brain injuries. Haarbauer-Krupa, Moser, Smith, Sullivan, and Szekeres (1985) proposed that using a “feature analysis guide” like that pictured in **Figure 1** with individuals in the middle stages of cognitive rehabilitation “helps patients to reestablish access to knowledge; to maintain an organized or direct search of information in storage; to focus and shift attention, to classify and organize effectively, and to develop metacognitive awareness” (Haarbauer-Krupa et al., 1985a, p.303). The intention is initially to use a structured procedure, but then to instruct and demonstrate at varying levels depending on level of need - isolating certain features concretely and demonstrating others at a more abstract level. Various activities can be used to demonstrate each of the features, such as sorting items into various ‘groups.’ The goal in other words is not one of word retrieval, but to use semantic features to organize thoughts, which is essential for reasoning, problem-solving, and judgment (Haarbauer-Krupa et al., 1985a). No longer primarily used for rehabilitation of persons with traumatic brain injury, Semantic Feature Analysis is now most commonly used in the treatment of word retrieval deficits for persons with aphasia.

Theoretical Basis

Two possible levels of processing may be impaired in persons with aphasia causing word retrieval deficits (Levelt, 1999). These impairments can occur at either the semantic or the phonological level. Some researchers theorize that providing intervention based on the error type exhibited and level of breakdown will thus be most beneficial to the person with aphasia (Hashimoto, 2012). This is where the rise of two distinct word retrieval interventions become evident in the literature: those incorporating Semantic Feature Analysis (SFA) and those with a focus on phonological components analysis (PCA) (Hashimoto, 2012; Neumann, 2018; van Hees et al., 2013). The premise behind these two interventions are similar, with one focusing on semantics and the other focusing on phonological-based naming deficits (rhyming, sound associations, etc). The general rationale for the success of Semantic Feature Analysis is through the theory of spreading activation; strengthening semantically-related neural connections thereby increases the automaticity of naming (Boyle & Coelho, 1995).

Traditional SFA Protocol

Treatment using a traditional Semantic Feature Analysis method is quite straightforward. Materials needed to employ this method include an SFA chart (**Figure 1**) and a photograph(s) of the target item(s). There are traditionally six semantic features found on an SFA chart, which are: group, use, action, properties, location, and association (Boyle & Coelho, 1995).

First, the photograph of the target item is placed in the center of the worksheet, and the client is asked to name the picture of the target item. Then, whether the individual is successfully able to retrieve the name of the item or not, the individual is provided with cues and guidance to complete each section of the chart (Boyle & Coelho). For example, suppose that a target word is "apple." The individual would be encouraged to indicate that an apple is a fruit (group). The person with aphasia is encouraged to provide as much information about the target item as he/she can but is guided and supported with cues as needed. Another prompt to the person with aphasia would be related to its function (what do you do with it?), and yet another to its physical properties (an apple is round, it can be red, green or yellow, it has a stem, etc.). Again, the role of the clinician is to provide prompts and cues throughout the process assisting the client with content as needed (providing missing features if the client is unable to list content in a section) and also with physically writing on/filling in the chart itself as the client describes the target item. Once the chart is complete, the client once again attempts to name the target item pictured in the center of the sheet. If the client is still unable to name the target item, the clinician provides the name of the item. Then, the features of the item are reviewed once more (Boyle & Coelho). Traditionally, this process was completed only with nouns, and only at the naming or 'impairment' level. Since its inception, however, some researchers/clinicians have made modifications to the traditional SFA chart and its use or application with persons with aphasia.

Variations of Semantic Feature Analysis

As noted above, the majority of work using Semantic Feature Analysis has primarily been with nouns and at the single word (impairment) level. Because this method has been so successful as a naming intervention, however, several modifications have been made and trialed to determine how far-reaching the benefits of SFA may be.

There has been considerably less emphasis on verb retrieval in aphasia research (Wambaugh & Ferguson, 2007); however, two past studies specifically targeted verbs using Semantic Feature Analysis. In a 2007 single-subject design study by Wambaugh and Ferguson, 40 experimental stimuli (black and white line drawings) depicting action words were chosen and divided into four lists of 10 items each. Discourse samples (picture descriptions, descriptions of procedures, narrative of personal information) were collected, recorded, and then transcribed and scored for production of correct information units (CIUs; Brookshire & Nicholas, 1993). CIUs were then classified into either a 'noun,' 'verb' or 'other' group. Criterion for completion of treatment was naming items with 80% accuracy on three consecutive sessions or a ceiling of 12 sessions. Treatment was applied to two of the four lists, while the other two lists were used for purposes of generalization assessment. Since target words were verbs, the traditional SFA chart was modified to include the following categories: subject (who usually does this), purpose (why does this happen), part of body/tool used to carry out action (what part of the body or what tool is used to make this happen), description of physical properties (tell me what it looks like), usual location (where does this action usually take place), and related objects or actions that reminded the participant of target verb (what does it make you think of). Please refer to **Figure 2** for an example of this modified SFA chart retrieved from Wambaugh, Mauszycki, and Wright (2014). The overall results of the Wambaugh and Ferguson study showed positive changes for trained action words. There was, however, no generalization in the ability of the participant to name untrained verbs.

The second study that modified traditional SFA to target the retrieval of verbs as opposed to nouns was conducted by Wambaugh, Mauszycki, and Wright in 2014. This was a follow-up study to the original Wambaugh and Ferguson (2007) pilot study described above. In this study, four participants followed the same procedures as outlined above, generating semantic features for verbs with the guidance of a speech-language pathologist using the same modified categories depicted in Figure 3. Mastery criteria were slightly different in this follow-up study: 90% accuracy on two consecutive probes or a ceiling of 12 treatment sessions. Results of the study showed increased verb naming for trained items for three of four participants, which was maintained two and six weeks post-treatment. There was no generalization to naming any untrained action words.

There have been two previous studies that have targeted both nouns and verbs within the same study. Marcotte and Ansaldo (2010) modified the traditional Semantic Feature Analysis approach. They implemented SFA with one participant who had severe Broca's aphasia as a result of a stroke and one participant who had severe, non-fluent primary progressive aphasia (PPA), and a "profile similar to a chronic Broca's aphasia" (Marcotte & Ansaldo, 2010, p.55). Based on words chosen through assessments during two baseline sessions, 15 nouns and 15 verbs were chosen as target stimuli. If a picture was accurately named, researchers immediately moved to the next stimulus item. If the participant was unable to name an item, Semantic Feature Analysis was used to prompt the person with aphasia. After three prompts, the target word was provided, and the participant was asked to repeat the word. The criterion level of 80% accuracy was reached after three weeks for both participants. Results indicated that Participant 1 demonstrated an ability to name all targeted nouns and 12/15 targeted verbs. He was able to name 4/30 of the untrained nouns/verbs. Post-training brain imaging results (event-related fMRI) showed that more "naming-specific" areas were activated compared to those prior to the intervention (this included the left superior temporal gyrus and the left middle temporal gyrus including Wernicke's area for verbs, and the right precentral gyrus and superior central gyrus bilaterally for nouns). In the case of the participant with PPA, 14 target nouns and 14 target verbs were successfully named after three weeks of SFA intervention. Results did not generalize to any untrained stimuli. Brain imaging results for this participant showed mostly right hemisphere recruitment for correctly-named items, and contrary to the first participant, imaging results revealed greater semantic processing activation post-therapy compared to pre-therapy. Overall results of this study showed improvements for trained items but little generalization to untrained nouns or verbs.

A second study using Semantic Feature Analysis to target both nouns and verbs was completed in 2015 by Kristensson, Behrns, and Saldert. In this study, three persons with mild-moderate anomia post-stroke (Wernicke's, mixed non-fluent aphasia, and Broca's aphasia) participated in a semantic-based intervention targeting both nouns and verbs. Dependent variables of interest included generalization to untrained items, generalization to participation in conversation, generalization to qualitative speech characteristics, and generalization to perceived functional communication. There was a total of 20, 1-hour intervention sessions per participant taking place over a period of five to six weeks. Typical Semantic Feature Analysis protocols were followed, with modifications to the chart to accommodate for verbs as was done in the Wambaugh et al. (2014) study described above (see **Figure 2**). A time limit was placed on participants, who were given 15 seconds to provide a response to a feature on the SFA chart before being prompted with a cue. In this study, for the participant to have received credit for naming an item correctly, he/she must have provided the target word within six seconds. Results indicated no generalization to untrained words for the individual with Wernicke's aphasia or with mixed non-fluent aphasia. There was generalization for the participant with Broca's aphasia, but these increases were not significant. None of the participants exhibited generalization to participation in conversation or generalization to qualitative speech characteristics. The Communication Outcome After Stroke (COAST) scale (Long, Hesketh, Paszek, Booth, & Bowen, 2008) was used to measure generalization to perceived functional communication, and these scores were largely unchanged post-intervention and actually decreased in one instance. Overall results showed no significant generalization of SFA-trained words to functional communication tasks. The investigators suggested that this may have been due to a lack of sensitivity of the scales used to measure subtle changes that may have occurred. They noted that the use of both verbs and nouns may have been confusing to participants, the amount/frequency of intervention time may have been insufficient, and that SFA may not have been a suitable treatment choice for all three of these participants.

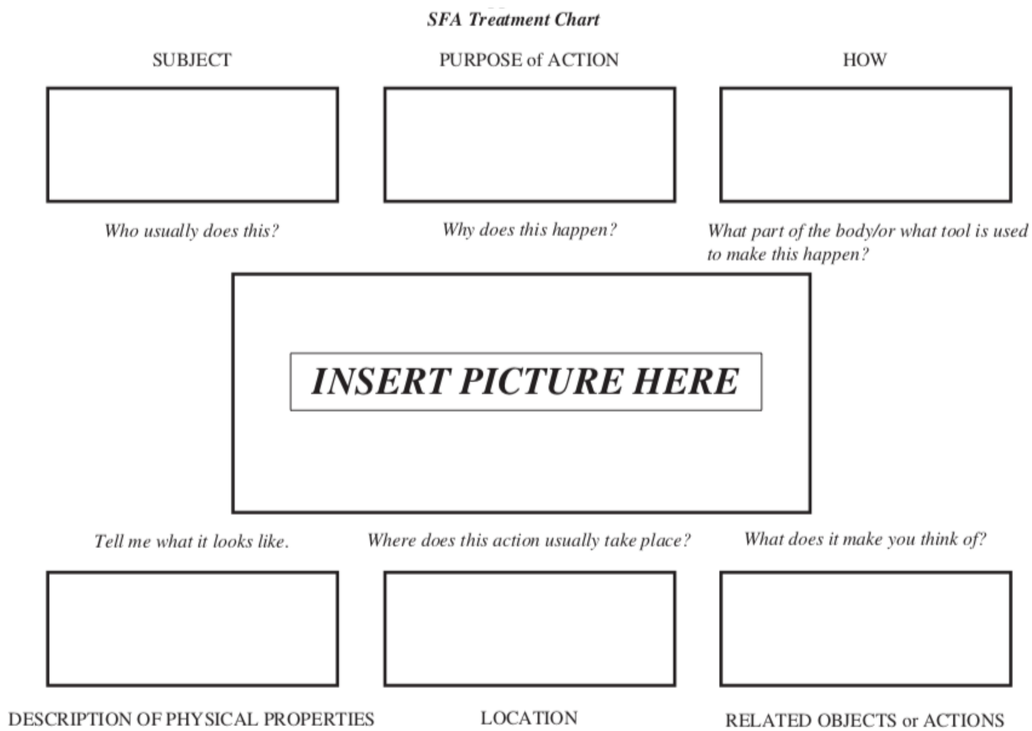


Figure 2 – SFA chart modified for action words (Wambaugh, Mauszycki, & Wright, 2014)

There have been several studies that have used Semantic Feature Analysis in an attempt to target word-finding impairment at the discourse level. Peach and Reuter made slight modifications to the traditional SFA protocol in their 2010 study that targeted both nouns and verbs. The goal in this study was to reduce the number of word retrieval failures at the discourse level by teaching SFA at a discourse level a priori, rather than as a compensatory strategy for discourse level tasks by using traditional SFA interventions in picture-naming tasks. Two bilingual participants with anomic aphasia (one with mild anomic aphasia, and one with moderate anomic aphasia) participated in this study. Treatment stimuli were picture scenes involving two or more events, and questions related to procedural information such as, “How do you shop for clothes?” Line drawings were used to assess picture naming ability, and to examine whether the discourse-based SFA treatment would generalize to picture naming ability. Discourse samples were recorded, and participant responses were limited to two minutes per stimulus item. Transcriptions of discourse samples were analyzed to identify instances of “word-finding behaviors” including verbal paraphasias, initial sounds, and comments. During the treatment phase, participants were asked to describe two picture scenes, and asked two procedural questions per session. A list of “failed lexical items” from these discourse tasks were then used as targets during Semantic Feature Analysis intervention, pairing the target word with the target task (the picture scene) that the “failed” item was from. Three to four words were typically targeted per session, with additional words being sent home with the participant to work on independently as a homework task to be reviewed the next session. Modifications to the SFA chart itself included a blank text box in the center of the chart for nouns (in lieu of the traditional target picture box), as well as modifications for a verb version of the chart (inclusion of a “synonym” section for example – See **Figure 3** for an example of the Peach and Reuter’s modified SFA chart for use with verbs). Treatment probes were administered every four sessions. Other than the modifications noted above, interventions mimicked those employed in traditional SFA interventions for picture naming (Boyle, 2004). Overall results of the study yielded meaningful improvements in “verbal productivity and improved informativeness in their discourse” (Peach & Reuter, 2010, p. 986). There were some improvements in picture naming; however, these improvements were not maintained during post-testing. Despite improvements in other areas, there was no significant change in word-finding behaviors (in frequency or in type) for either participant at the discourse level. The researchers suggested that results were limited due to unstable and variable performances during baseline and throughout the treatment period, and they suggested that a longer baseline period would have reduced this confounding factor They proposed that the novelty of the discourse and procedural stimuli used in the study also may have contributed to the highly variable results.

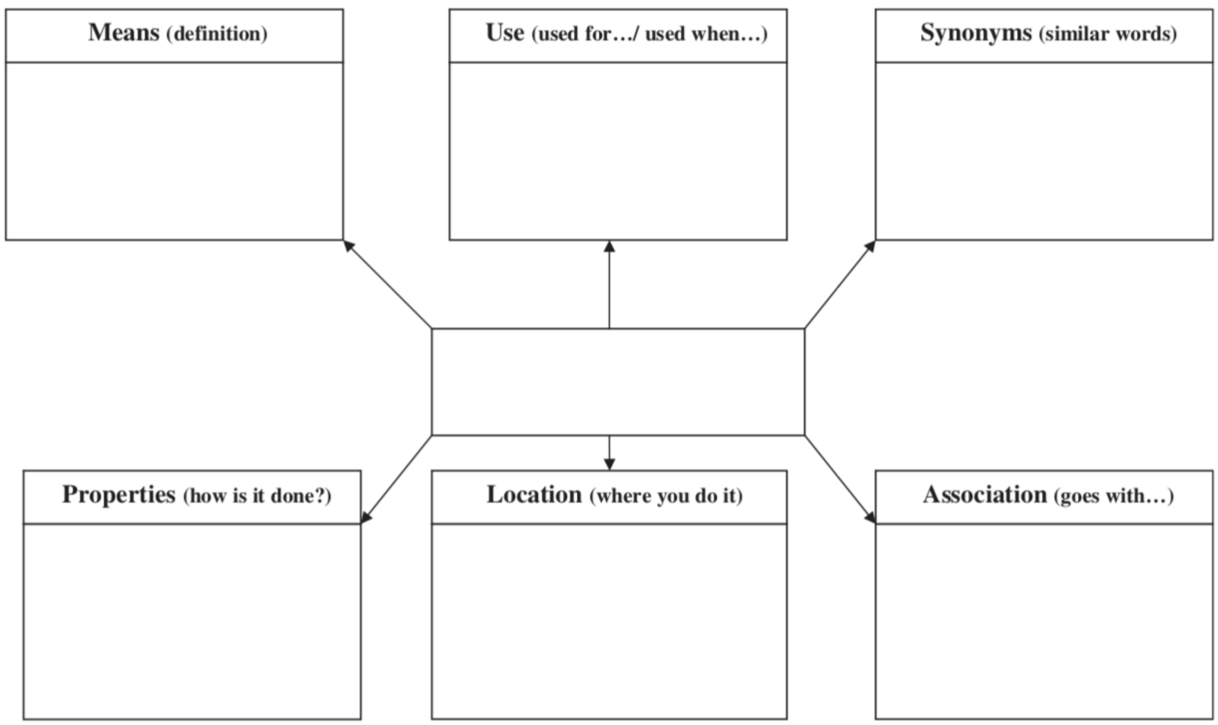


Figure 3 –Modified SFA chart for use with verbs (Peach & Reuter, 2010)

There have been two studies that have made use of Semantic Feature Analysis for word-retrieval within a group intervention context. The first was a 2009 study by Antonucci during which two participants attended group sessions for 60-90 minutes for seven weeks (results for a third participant were not reported as the participant withdrew due to illness). One participant was classified as having Conduction aphasia, and one presented with Anomic aphasia according to the Western Aphasia Battery classification (Kertesz, 1982). Baseline stimuli and probes included description of picture scenes, requests for procedural information, and an additional discourse task, and as in the previous study, performance was based on calculation of correct information units (CIUs; Nicholas & Brookshire, 1993), as well as %CIUs, and CIUs/minute. Effect sizes also were calculated as were successful word and noun retrieval attempts in discourse. Inter-rater reliability agreement for this study was 87% accuracy for dependent variables. Since this was a study conducted in a group setting, there were some modifications made to the traditional SFA protocol. First, the SFA chart was enlarged to a 2 by 3 foot poster size for the participants to see. Brief descriptions also were included for each of the box labels. The first two sessions focused on facilitating the use of SFA, and the researcher used open-ended questions and cloze phrase cues as needed with all features being added to the chart as they were produced by the participants. Once the chart was completed and features reviewed, a phonemic cue was provided. If the phonemic cue failed to elicit the name of the item, the researcher said the name of the item and the participant repeated it (Antonucci, 2009). During the remaining sessions, a modified PACE approach (Davis, 2005) was used to describe pictures to other members of the group while using SFA at the discourse level. Participants were provided with a picture scene and were instructed to describe the scene in enough detail that another participant could guess the scene. They were guided through the SFA protocol during this process to help enrich their picture descriptions and assist with word retrieval. The communication partner was encouraged to ask for clarification or additional description when something was unclear. Once the scene was described, the communication partner was asked to choose the described scene from a field of three to four similar scenes. The nature of the discourse tasks evolved in complexity level as the treatment sessions progressed (single picture scenes, single picture scenes with a problem to identify, picture sequences with 2-5 pictures, picture sequences with pictures removed, retelling a fairy tale without pictures, re-telling the plot of a movie). The ability to self-monitor and the independent use of strategies increased over the course of treatment, and participants were provided with business card-sized copies of the modified SFA chart to take home. Results indicated that there was in increase in overall informativeness in discourse for both participants. Efficiency of communication did not increase for the participant with Conduction aphasia, who required a "greater number of words to increase communicative informativeness, [and] %CIUs and CIUs/minute did not change" (Antonucci, 2009, p. 864), while the participant with Anomic aphasia demonstrated improvements in these areas, as well as a reduction in pauses during connected speech. Although participants were provided with business card-sized copies of the modified SFA chart to take home, and participants anecdotally reported use of SFA techniques outside of the group sessions, Antonucci did not track use of these cards outside of the session or attempt to objectively measure impact on communication or generalization outside of the aphasia group setting. It is also important to note that all communication partners involved in the intervention had word retrieval deficits and were being trained in the same protocol, whereas most communication partners that persons with aphasia will encounter in their everyday life will not be persons with aphasia and will not have been trained in the use of these same strategies.

In the second study targeting group treatment with Semantic Feature Analysis, Falconer and Antonucci (2012) expanded on the original group study. Four persons with chronic aphasia participated. The same procedures and modifications were used as outlined above in the original Antonucci (2009) study; however, group sessions were slightly longer (1.5-2 hours in length each). Additionally, this time, a homework component was included to promote generalization of skills. Homework increased in complexity each week and was self-tracked by the participants on a homework log. Homework was collected at the beginning of each group session, and participants were given a score of 0 (not completed), 1 (partial completion), or 2 (full completion) on their homework. Homework was created such that it could be done independently and did not require a communication partner for completion. The first two participants in this study showed improvements in communicative efficiency, and Participant 2 demonstrated an ability to retrieve verbs more accurately. Participants 3 and 4 demonstrated increased communicative effectiveness, with the third participant producing fewer uninformative words and the fourth participant showing an increase in the number of CIUs (Brookshire and Nicholas, 1993). It is important to note that since this study as well as the original Antonucci study employed not only SFA, but also a supportive group PACE-like intervention approach (Davis, 2005) it is difficult to discern which treatment led to the improvements that were seen.

In a study by Knoph, Lind, and Simonsen (2015), a multi-lingual speaker with moderate, non-fluent aphasia participated in a modified SFA treatment intervention during an intensive schedule of 10 hours of treatment per week for two and a half weeks. The focus of the intervention was production of verbs at the sentence level. The native language of the participant in the study was Japanese. She learned English as an adult during an immersion program at school in the UK. She learned German fluently in Japan as an adult and then worked as a German-Japanese interpreter. Lastly, she learned Norwegian through immersion after moving to Norway as an adult. At the time of her stroke, her proficiency level in Japanese, English, and Norwegian was “high,” and was “medium” in German. Between 9 and 14 verbs were trained per session in Norwegian, and target words were presented in random order. Modifications were made to the Semantic Feature Analysis chart. These modifications to the traditional boxes can be seen in **Figure 4.** For the purposes of this study, a picture of a target action was placed in the center of the SFA chart, and the sections of the chart were completed in order as the participant was provided with semantic or phonological cues as needed to complete it. Once the chart was completed, the participant was asked to name the target verb. If the participant was unable to name the verb, the target word was provided, and the participant was asked to repeat it. Then the person with aphasia used the word in a simple sentence; positive feedback was provided for appropriate sentences, and if necessary, assistance was provided for sentence creation, and the participant would then repeat the sentence. An action naming test (administered in English and Norwegian), the Bilingual Aphasia Test (administered in all four target languages) (BAT; Paradis, Libben & Hummel, 1987), and elicitation of a personal narrative that was audio-and video-taped and transcribed, were administered before and directly after the SFA treatment period. It was of no surprise that trained words improved to a greater degree than verbs that were untrained. There was no generalization noted to untrained items on the action naming test within a respective trained language. There were no improvements in the semantic or syntactic areas of the BAT in the treated language. Some cross-linguistic transfer occurred, with some generalization to German but none to Japanese. Although there were no clear improvements in the number of CIUs (Brookshire & Nicholas, 1993) in untreated languages, sentences showed greater complexity and increased tempo in the treated language. Lastly, there was no evidence to suggest any inhibition of untreated languages. Results of the study suggested that bilingual or multi-lingual speakers may have “one shared conceptual system for all of their languages” (Knoph et al., 2015, p. 1492).

HVEM GJØR DETTE VANLIGVIS? *Who does this usually?*	HVA BLIR DET GJORT MED? *What/who is it done to/with?*	HVOR SKJER DETTE VANLIGVIS? *Where does this usually happen?*
________________________	________________________	________________________
	MÅLBILDE *Picture of target word*	
HVORFOR SKJER DET (MENINGEN)? *Why does it happen?*	HVILKEN DEL AV KROPPEN/HVILKET VERKTØY? *Which part of the body/What tool is used?*	HVA FÅR DET DEG TIL Å TENKE PÅ? *What does it make you think of?*
________________________	________________________	________________________

Note: English translation in italics.

Figure 4 – Modified SFA chart for use with verbs in a cross-linguistic study (Knoph, Lind, & Simonsen, 2015)

In a 2012 study by Hashimoto comparing Semantic Feature Analysis (SFA) and phonological components analysis (PCA), the traditional SFA chart was modified to include only three of the features: group, physical-sensory properties, and association. Three feature areas were selected by Hashimoto to see if limiting the number of features would still result in word retrieval improvement. Likewise, three phonological features (rhyme, first sound, and number of syllables) were selected for the PCA portion of the treatment. Participants were seen twice per day for 45 minutes to an hour two times per week. Other than the number of features being reduced from six to three, the intervention followed the same protocol as traditional SFA. All trained items were completed in each session. Once performance reached above 80% accuracy for three consecutive sessions, the next set of words was trained and then treatment was complete. Responses were scored as either correct or incorrect. In terms of the modifications to the SFA, it appeared as though reducing the number of features actually resulted in improved word naming of trained items. There was judged to be moderate generalization to an untrained set for one of the two participants in the study and limited to no generalization for the other participant. Both SFA and PCA treatment approaches yielded significant treatment effects. Hashimoto suggested that this could be because both semantic and phonological processes are activated and thus strengthened during each of these activities, or because the participants (and persons with anomia in general) typically have mixed semantic and phonologic deficits.

In a study by Lowell, Beeson, and Holland (1995), three participants with moderate, chronic aphasia participated in a picture-naming intervention. During this intervention, a Semantic Feature Analysis chart was used to generate initial responses; four cues were then chosen from these participant-generated responses and were written down on index cards. During training, these four participant-selected semantic features were read out loud, and then the participant was asked to name the target item. Unlike the other studies described, two of the three participants showed generalization to untrained items. The authors hypothesized that this could be due to "repeated probes during semantic training, repeated opportunity to name, effectiveness of corrective feedback, or the repeated demonstration of the procedure" (Lowell et al. 1995, p. 112).

Discussion

A pattern that emerges in the literature is the issue of generalization. As can be seen from the brief literature review above, there is relatively strong evidence to support the use of Semantic Feature Analysis for trained items. When individual words are trained using SFA, often over multiple sessions, once learned, the person with aphasia is typically able retrieve that specific word, at least at the impairment level. The word retrieval issues remain, however, for words that have not been specifically targeted. Considering what traditional Semantic Feature Analysis entails (cueing, discussion, and working through the SFA chart until the person with aphasia can retrieve the target stimulus word), though it may be one of the more effective word-finding interventions, one could argue that it is not a particularly practical one. Still, of the various word-finding interventions available to date, semantic-based therapies have shown the strongest generalization data (Boyle, 2010; Coelho, McHugh, & Boyle, 2000).

In a recent meta-analysis by Quique, Evans, and Dickey (2019), person-and treatment-related variables from 12 studies were analyzed to determine the effect of SFA on treated and untreated stimuli. Not surprisingly, overall results demonstrated increased naming accuracy when comparing baseline naming probes to treatment naming phases. Additionally, there were greater gains for treated stimuli than for untreated stimuli, with increased treatment dosage being associated with increased naming accuracy for trained items. Gains also were greater for semantically related generalization items than for untrained items that were not semantically related to the trained items. In regard to aphasia severity, Quique et al. concluded that persons with milder aphasia as demonstrated by higher WAB-R (Kertesz, 2007) Aphasia Quotient (AQ) scores, may show “stronger response generalization after SFA” (Quique et al., 2019, p. 243). This meta-analysis provided information regarding overall aphasia severity and SFA dosage that had not previously been analyzed.

When delving further into the literature we can compare individual studies. There is a significant amount of variability in the amount of treatment intervention time involved in the studies described above, ranging from 540 minutes of total treatment time (Marcotte & Ansaldo, 2010) to ~1470 minutes of total treatment time (Falconer & Antonucci, 2012). Severity level and type of aphasia is also variable. There is also quite a limited number of participants in each of these studies, as is the case in most aphasia research.

There does not seem to be any evidence to suggest that minor changes to the SFA chart itself hinders the success of the word retrieval process for the participants (Antonucci, 2009; Falconer & Antonucci, 2012; Kristensson et al, 2015; Marcotte & Ansaldo, 2010; Peach & Reuter, 2010; Wambaugh & Ferguson, 2007; Wambaugh et al., 2014), and that some modifications may in fact help to enhance the word retrieval process (Hashimoto, 2012). Still, these changes do make it difficult to discern which aspects of SFA make it most effective. Lastly, effect sizes were reported for the majority of the studies; however, in most cases, overall results showed small effect sizes.

Expanding Expression Tool (EET)

The Expanding Expression Tool (EET) was developed in 2007, by a school-based speech-language pathologist, Sara Smith. She developed the tool after seeing a need for her elementary-aged students to have a visual and tactile stimulus to be successful with verbal descriptions (Smith, 2008).

The EET tool itself consists of a strand of rope, holding seven different colored balls, each representing a different language element used to describe an object. The colored balls can be slid up and down across the rope. The first ball is green and represents the group or category in which an item belongs. Ball 2 is blue and represents the function of the item. This can be what the item does or what someone can do with the item. The third ball boasts an icon of an eye, which represents what the item looks like (size, shape, color). The fourth ball is wooden, which represents the material from which an item is made. The fifth ball is pink and represents the parts of a target item. Ball 6 is white and represents location. The seventh and final ball is orange in color and has a question mark symbol. Descriptions using this ball include other prior knowledge or facts that do not correspond with other previously-named balls.

Use of the EET first involves learning what each of these balls represent, which is learned through memorization of the rhyme “Green-group, blue-do, what does it look like, what is it made of, pink parts, white where, what else do I know.” The program also comes with a manual filled with worksheets and activities to support student learning and teaching of each of these different categories as well as supporting materials such as large dice with the corresponding symbols on each side, stickers, and an EET poster highlighting each category (EET, 2008).

While the EET tool was developed using components from existing theories and strategies that are heavily researched (use of multi-sensory mnemonic devices, metalinguistic strategy instruction, Semantic Features Analysis), there are no known peer-reviewed publications to date that document the effectiveness of the EET in any population. Rather, research using this tool is limited to unpublished works independently conducted by school districts or teachers who have implemented use of the EET in their classrooms, and one single-subject research study conducted through Rocky Mountain University in Utah and presented in poster form (Rau, Simpson, & Balthazar, n.d.).

In the single-subject research study entitled *The Expanding Expression Tool Program: Effects on Verbal Descriptions Produced by Children with Language Impairment*, Rau et al. (n.d.) explored whether standard use of the EET tool would lead to an increase in the “number and type of attributes in verbal descriptions of common nouns.” There were two elementary school-aged participants in this study, each with existing expressive language goals on individualized education plans (IEPs). The participants each received a total of 15 30-minute sessions, data were collected via a probe at the beginning of each session, and a point-based scoring system was provided (1 point for each correct attribute, and 2 points for providing a category, averaging to yield a ‘Verbal Descriptions Score’). Scores for both participants in this study showed a statistically significant increase in number of correct attributes and type of attributes. The discussion section noted that one participant began to generalize the chant to the probe task in Session 14, whereas the other participant began using EET strategies without cues in Session 13; however, there is no indication prior to this that data were taken on ability to independently generalize or sing the EET chant, nor is there any mention about amount or level of cueing used throughout intervention sessions.

In a document provided by the author of the EET (Smith, 2018), a project was conducted by an unknown person in 2007 as a part of a teaching practicum requirement. For this project, a writing sample was collected from a 7th grade English class during a journaling activity, during which students were asked to write down and describe everything they knew about a 'basketball' while a basketball was gently tossed around the room as a visual aid. Writing samples were scored based on inclusion of EET criteria included in the writing (group, function, look, etc). This initial sample served as the baseline data, with 89% of the class including three or fewer EET 'types.' The EET tool was then presented to the students who split into small groups and practiced using the tool. Students were then divided by gender to see who could yell the chant the loudest. The following day, students were provided with their original basketball journals and a 'self-check' sheet to score their writing. A new topic was then provided along with a graphic organizer and a self-check sheet, and students were given the instruction to write down and describe everything they knew about the item. This score served as their post-treatment score with 89% of the class including four or more EET 'types.' As this was an informal, unpublished study, there is a tremendous lack of detail and information included. There is no indication how long students were trained, how students were paired, what type of activities they did while paired, what the second target word was, what types of cues were provided to students, etc.

Additionally, students were given a graphic organizer for their post-test that they were not provided with during their baseline journal entry.

In a report by Hudsonville Christian School in Michigan (DeWeerd &McCann, n.d.) and provided by the creator of the EET (S. Smith, personal communication October 24, 2018), the authors used a quantitative approach to determine if details in writing samples of second grade students would increase as a result of teaching use of the EET. In this study, a pre-test/post-test model was used, and one group of second grade students was provided with instruction in EET for an 8-week period, while a second group of like-aged students did not. Pre- and post-test writing samples were scored independently by the two researchers using the checklist provided in the EET kit. After eight weeks, the group trained in use of the EET showed gains of an additional 34 details in their writing samples, whereas the non-EET group had an additional eight details. By overall percentage, 76% of students in the EET group had increases in their writing details, and by comparison, 40% of the non-EET group increased in detailed writing ability. Some detail is once again lacking in this study as there is not indication as to how long was spent on each ‘section’ of the EET, or what type of instruction the non-EET group received. Additionally, the intervention was provided for eight weeks, but there was no indication of how long the interventions were (did the intervention take place daily, once per week, how long was each EET intervention?). Several questions were identified by the authors in this study, including whether there is an optimal age at which to introduce the EET, if the EET strategies need to continue to be taught after direct instruction, and if use of the EET could generalize to improve school-wide test scores (DeWeerd &McCann, n.d.)

In a brief report provided by Sara Smith (personal communication, October 24, 2018), creator of the EET, White Pine Academy released their Michigan Educational Assessment

Program (MEAP) score writing test results in 2009, with significant increases. The school was in its second full year of using the EET program and attributed its increase in writing test scores to the implementation of the EET. The school reported that third grade testing results on this measure increased by 7%, 4th grade by 32%, and 5th grade by 2% (Waugh, 2009).

Use of the EET is strongly supported by clinicians as an intervention strategy, particularly in the elementary-aged population, and although its use is supported through unpublished studies by clinicians and student work samples, there are no known peer-reviewed research articles to support its use. The unpublished works described above are lacking in detail and would not be easily replicable. In several of the releases, information is missing regarding the methods used throughout the intervention. Time spent in intervention is not indicated in several studies. Several of the studies do not indicate who was administering the intervention (SLP, teacher, student teacher, administrator), and the amount of support provided to students was not specified. In one study, additional support was provided to students during the post-test (students were provided with a graphic organizer that they did not have during the pre-test writing sample). There was also a wide range of number of students and ages included (if demographics were included) from a single-subject study with two students to a report of a whole school with an unknown number of students participating in use of the EET. Ages ranged from 2nd grade to 7th grade.

Most known mentions of the EET have been limited to unpublished or non-scientific sources. In addition to those above, these have included blog posts, a short 2008 newspaper article in the Bay City Times (Brandt, 2008), and clinician report. Despite the lack of strong empirical evidence to support outcomes after use of the Expanding Expression Tool itself, clinicians who have used the EET show strong support in favor of the tool. It is also important to remember that this tool was originally developed for use with pediatric populations. There are no known studies, published or otherwise, that discuss its use with adult populations. Still, the development and theory behind this tool (heavy reliance on semantic features, multi-sensory component) should lend itself nicely to add additional support for word-finding remediation in an adult aphasic population.

Purpose

The long-term goal of this line of research is to optimize the implementation of Semantic Feature Analysis (SFA) to increase its generalized effects on word-finding abilities, making it more useful for helping persons with aphasia to compensate for, if not to overcome, their word retrieval deficits.

The first step toward this long-term goal is the proposed study, in which my special interest is to develop and test a unique approach to word retrieval problems in persons with aphasia that leads to more accurate recall of trained words, semantically related but untrained words, and untrained words semantically unrelated to the trained words than has been demonstrated to date.

The primary goal of this study was to determine whether participants with aphasia would improve their naming of pictured nouns through the use of the Expanding Expression Tool (EET). In that regard, the following research questions were addressed in the current research. 1) Does training with the Expanding Expression Tool (EET) result in an increase in naming treated pictured nouns? 2) Does training with the EET result in an increase in naming untreated words in the same semantic category as the treated words? and 3) Does training with the EET result in an increase in naming untreated words in a different semantic category from the treated words?

Secondary outcome questions to be examined included the following four questions: 1) When persons with aphasia experience word-finding difficulty, will they spontaneously use the EET in the context of naming trained pictured nouns? 2) When persons with aphasia experience word-finding difficulty, will they spontaneously use the EET in the context of naming untrained pictured nouns? 3) Does the number of semantic features produced by the person with aphasia during training sessions affect the ability to name trained pictured nouns? 4) Does the number of semantic features produced by the person with aphasia during training sessions affect the ability to name untrained pictured nouns?

Chapter 3: Methods

Participants

Four persons with word retrieval deficits secondary to stroke with chronic aphasia were consented, and of these, three individuals qualified to participate and completed the study. The participants were recruited via various sources including previous aphasia studies conducted through the University of Kansas Medical Center, via the Aphasia Group at the University of Kansas Medical Center, individual clients from the University of Kansas Medical Center Hearing and Speech department clinic, and the Adult Communication Group at the University of Kansas in Lawrence.

All participants were diagnosed with aphasia secondary to left-hemisphere stroke, and were well over six months post onset. English was the primary language of all participants, with one participant reporting that he learned “some” conversational German years ago (EET004). Participants ranged in age from 74 to 78 years of age. Months post-onset of stroke ranged from 39 months to 129 months. Lastly, years of education ranged from 17 years to 21 years. All participants were right-handed. Two participants consented for themselves, whereas one participant had a surrogate decision maker and signed an assent form (See Appendices A,B, and C). Basic demographic information can be found in Table 1.

Table 1. Participant demographic information

Participant	Age	Months Post Onset	Years of Education	Race/Ethnicity	Gender	Handedness	Consent Type
1	74	60	21	White	M	R	Consent
2	78	39	17	White	M	R	Surrogate/Assent
3	77	129	17	White	M	R	Consent

Study participants all had functional hearing and vision as measured by informal hearing and vision screens. Functional hearing was defined as the ability to follow at least 4/5 one-step directions that were presented auditorily via a remote platform (see Appendix D). Functional vision was defined as scoring at least 4/5 on a picture-matching task using black and white line drawings. This task required the participant to match a target stimulus item to one of four items within a stimulus set (see Appendix E). The vision screening was conducted remotely with the assistance of a family member/caregiver to give stimulus items to the participants. None of the participants presented with or reported having other confounding neurological conditions.

Before qualifying for the study, participants were presented with and asked to name pictured nouns within semantic categories (up to 30 pictures per semantic category). In order to qualify for the study, participants had to exhibit word-naming deficits by incorrectly naming at least 10 items on 2/3 trials in each of four semantic categories on probe items prior to the initiation of the study, while correctly naming at least three items within each of these same categories.

If participants did not name at least 10 pictured nouns incorrectly out of a maximum of 30 pictured nouns on 2/3 trials within the same category, then the next category was trialed. Participants had the opportunity to meet the qualification requirements (10 incorrectly named nouns on 2/3 trials and at least three named correctly within that semantic category for four categories) for up to eight categories, after which it was determined that they did not qualify for the study. This was the case for one of the consented individuals who was able to name too many items within the categories to qualify for the study.

Presence and severity of aphasia was confirmed and classified by the Western Aphasia Battery-Revised – Part 1 (Kertesz, 2007).

Study Personnel

The primary researcher, Kelly Zarifa, was responsible for the development of the protocol, consenting of the participants, screening of participants, administration and scoring of initial baseline measures, treatment intervention, data collection, and collection of follow-up probes.

Measures and Stimuli

A demographic information form was used to collect basic demographic and medical information at baseline (Appendix F). Brief, informal hearing and vision screens as described above were administered to ensure that participants were able to see and hear testing and intervention tasks (Appendices D and E).

Part 1 of the Western Aphasia Battery-Revised (WAB-R; Kertesz, 2007) was administered to assess speech content, fluency, auditory comprehension, repetition, and naming. Combined, these sections of the WAB-R were used to calculate an Aphasia Quotient (AQ) for each participant in the study, which is a measure of aphasia severity. Scores from Part 1 on this measure also were used to determine the WAB-R Aphasia Classification type (i.e., Broca's, Wernicke's, etc.) Scores on this measure can be found in Table 2.

The Boston Naming Test – second edition (BNT-2) is a standardized tool used to measure confrontation naming abilities (Kaplan, Goodglass, & Weintraub, 2000). The BNT includes 60 items that are more challenging/less common words than those found on the WAB-R (Kertesz, 2007). This measure was administered to all participants and was re-administered during post-testing procedures during the 6-week post-treatment probe. Scores on this measure can be found in Table 2.

The Pyramids and Palm Trees Test (Howard & Patterson, 1992) was administered to all three participants to assess semantic processing abilities. Specifically, the picture-only version of the measure was used so as to gain knowledge about the participants' semantic abilities without the influence of linguistic ability. Tasks on this measure include triads consisting of the test item, a corresponding target item, and a foil item (e.g., test item = pyramid, target item = palm tree, foil item = fir tree). Scores on this measure can be found in Table 2.

Table 2. Participant scores on standardized assessment measures

Participant	Aphasia Type	Western Aphasia Battery-Revised (WAB-R) Object Naming	WAB-R Naming and Word Finding	WAB-R Aphasia Quotient (AQ)	Aphasia severity Level	Pre-test Boston Naming Test (BNT) score	Pyramids and Palm Trees	Post-test BNT score
1	Anomic	60/60	8.9/10	82	mild	51/60	47/52	56/60
2	Broca's	41/60	6/10	62.2	moderate	24/60	41/52	28/60
3	Conduction	27/60	4.2/10	60.9	moderate	8/60	48/52	12/60

The Bank of Standardized Stimuli (BOSS; Brodeur, Guerard, & Bouras, 2014) Phase II photos were used as target items during the baseline and intervention phases of the study. The BOSS is a database that provides normative information for visual stimuli on more than 15 dimensions. Specific dimensions that were balanced across stimuli were familiarity and visual complexity. Although previous studies have not indicated that visual complexity has made a large impact on ability to successfully name pictured items in this population, and familiarity has been a very low predicting factor on naming ability (Laiacona, Luzzatti, Zonca, Guarnaschelli, & Capitani, 2001), using normed stimuli balanced for visual complexity and familiarity ensured no advantage for treated or untreated words. The database includes colored photos across multiple semantic categories including kitchen/utensils, natural elements, outdoor activity/sport items, etc. During the initial screening process, the BOSS photos were used to determine specific stimuli/semantic categories for each participant. Forty items were chosen for each participant – ten stimuli in each of three different and unrelated categories that the subject could not name across at least two trials per item, and 10 additional items in a different and still unrelated semantic category that remained untreated throughout the study. See Appendix G for a complete list of target items for each participant.

The Expanding Expression Tool (Smith, 2008), which is a visual and tactile tool used to promote verbal description, was used during treatment sessions. The EET itself is comprised of a rope with seven different colored balls, each representing a different language element (Appendix H). A full description of the EET can be found on page 22 in the Literature Review section. The EET strand was used in conjunction with a poster board with a description of each of the “rhymes” and definitions that the balls represent. Each participant had in-person physical access to the EET rope and poster board with descriptions throughout each treatment session. A Semantic Feature Analysis chart, which was modified to correspond with the target features on the EET strand was not accessible to the participants and used only by the primary investigator for data collection purposes. The modified Semantic Feature Analysis chart can be found in Appendix I.

Procedures

Approval for completion of the study described herein was obtained from the University of Kansas Medical Center Institutional Review Board after significant modifications were made to change this study from an in-person study to a fully remote study secondary to suspension of research due to the COVID-19 pandemic beginning in Spring of 2020. For a brief outline of COVID-19 related study changes, see Appendix J.

Informed consent was obtained from each participant before the study began. The primary investigator (PI), Kelly Zarifa, met with the potential participants one-on-one (or with a family member present) during the recruitment process via Zoom. The consenting took place over a secure telehealth Zoom line with the subject with aphasia, the surrogate decision-maker, and/or family member of the person who had aphasia. The PI emphasized that participation was voluntary and that stopping the study at any time would be allowable. The study was explained verbally, and the individual had an opportunity to ask questions. Signatures to acknowledge consent to participate in the study were secured after the meeting using DocuSign. Once a subject consented to participating in the study, he was assigned a participant pseudonym in order to deidentify information and preserve confidentiality (e.g., EET-001).

Basic demographic and medical information was collected from each participant via the Demographic Information Form (Appendix F). Next, participants were screened to ensure that they had adequate vision and hearing to participate in the study (Appendices D and E). Finally, participants were given a confrontation naming task using stimuli from the Bank of Standardized Stimuli (BOSS; Brodeur et al., 2014). During this task, participants needed to show a pattern of word-finding deficits by being unable to name at least 10 items within a category of items for at least four categories. This established the stimuli sets that were targeted during the intervention.

If the participant was able to name too many items within given categories, he was ineligible to participate in the study.

Once eligibility was established (the participant had met all inclusion and exclusion criteria based on information gathered through the demographic/medical information form, passed the vision and hearing screenings, and established word-finding deficits within category sets), standardized tests were administered. These tests included the WAB-R, Part 1 (Kertesz, 2007); the BNT (Kaplan et al., 2000), which was administered to participants to get a more in-depth standardized measure of confrontation naming; and the Pyramids and Palm Trees Test (Howard & Patterson, 1992), which was used to gain a better understanding of semantic processing abilities. Since the study was conducted entirely remotely, it is important to note that these tests were all administered in a non-traditional manner and with the assistance of family members or caregivers. Testing supplies were dropped off by the PI to the homes of the participants via no-contact drop offs at the front door, a day to a week prior to test sessions. During testing, family members/caregivers assisted by holding items up for the participant, locating and turning pages, reading items to the participant as needed, etc. These tests are not standardized to be administered remotely, so although tests were administered as closely to protocol as possible, scores obtained under remote administration may differ from scores obtained during face-to-face testing.

This study was designed as a single-subject multiple baseline study across behaviors and participants. Participants were seen via Zoom for their treatment sessions. The intention was to see participants without any family members or others present for treatment sessions, which was typically the case; however, occasionally there were persons in the background in the same room or off camera (not interacting) or in an adjacent room listening to the session who would occasionally make comments or insert themselves during the treatment session.

Baseline for Participant 1 was collected over a period of four data points, with intervention of targets within the first category beginning on Day 5. Starting on the first day of intervention, participants were introduced to the Expanding Expression Tool (EET). The "rhyme" for the tool was introduced: "Green group, blue do, what does it look like, what is it made of, pink parts, white where, what else do I know," and the participant could follow along on the portable EET strand that he could manipulate. During the treatment sessions, the first stimulus picture from the BOSS was introduced by screen-sharing a digital copy of the picture over Zoom, and the participant was asked to name the target. Standard Semantic Feature Analysis intervention was used to move along the EET strand as the picture was described, and the participant was provided with cues as needed. Meanwhile, the PI filled out the modified SFA chart (Appendix I) and other data collection pages indicating level of cueing (Appendix K) while the participant used the EET strand as a tactile and visual guide of how to describe the target stimuli. Once the participant completed all beads on the EET strand (with assistance as needed), the participant was once again asked to name the target item, and if unable to name it, the investigator provided a phonemic cue (e.g., the first two phonemes); the participant was given a second opportunity to name the target item, and then if unable to, the target word was provided. Then, the screen share was stopped, and next stimulus item was shared to the screen. The original goal for each session was to cycle through the five target words twice per session, but it was quickly discovered that words would only be targeted one time per session due to the length of time it took to complete the description task. The length of each session varied depending on the severity level of each participant and the proficiency with which he was able to complete the

EET strand naming activity, with sessions ranging from ~60 minutes to 2 hours. Sessions took longer at the beginning of each new category and tended to get shorter as participants became more familiar with the targets. Once treatment sessions exceeded the 60-minute mark, the PI began to generate the EET cues on behalf of the participant in order to increase the pace of the session and to get through the remaining target nouns. There were three occasions during which a single treatment session was split over two days due to participant request (EET004). Note that ten words were selected per category. Five words were treated during the intervention sessions, and the other five words within the category were untreated and used as probes. At the end of each session, all ten items were probed twice in random order with naming accuracy recorded. Prior to beginning the probe, participants were told that they could use the EET strand, but that no feedback could be provided during the probe. Since the goal was to name items, common synonyms were accepted (e.g., grocery cart & shopping cart were both accepted).

Once mastery criterion was met for the Category 1trained words, the pictured nouns within the second semantic category were introduced for intervention and were targeted in like fashion. The same process occurred for the third semantic category. Mastery level was considered 80% naming accuracy during end- of-session probes on treated items across three consecutive sessions. A maximum of 12 sessions of intervention per category (five treated words) were delivered before treatment for a given category was terminated if mastery was not reached. That meant anywhere from 3-10 sessions were completed for each category depending on performance.

Once the treatment phase ended, participants were asked if they practiced between treatment sessions. Participants EET001 and EET002 reported that they did not practice in between sessions. Participant EET004 did report practicing between sessions (which was evident during the sessions as this participant liked to discuss what he had looked up online about each of the target items). Follow-up probes took place at two and six weeks post-treatment. Participants were asked if they used their EET strands while on their break; none reported having used their EET strands. During follow-up probes, participants had access to their EET strands, and all 40 stimuli (trained and untrained) were probed. Additionally, the BNT (Kaplan et al., 2000) was administered as a standardized post-test measure. After treatment sessions were all completed, participants were provided with their portable EET strands to keep. Participants were offered compensation for completion of the study in the form of a $100 ClinCard. An overview of study procedures can be found in **Figure 5**

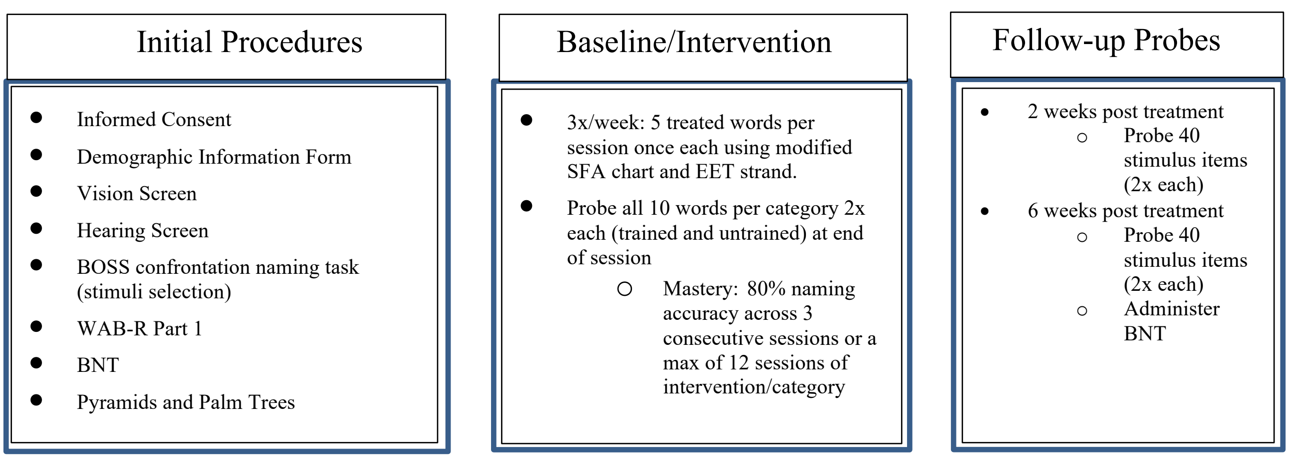


Figure 5: Study procedures

Chapter 4: Results

The goal of this study was to determine whether participants with aphasia would improve their word recall of pictured nouns through the use of the Expanding Expression Tool (EET). Thus, the primary research questions were: 1) Does training with the Expanding Expression Tool (EET) result in an increase in naming treated pictured nouns? 2) Does training with the EET result in an increase in naming untreated words in the <u>same</u> semantic category as the treated words? and 3) Does training with the EET result in an increase in naming untreated words in a different semantic category from the treated words?

Secondary outcome questions to be examined included the following four questions: 1) When persons with aphasia experience word-finding difficulty, will they spontaneously use the EET in the context of naming trained pictured nouns? 2) When persons with aphasia experience word-finding difficulty, will they spontaneously use the EET in the context of naming untrained pictured nouns? 3) Does the number of semantic features produced by the person with aphasia during training sessions affect the ability to name trained pictured nouns? 4) Does the number of semantic features produced by the person with aphasia during training sessions affect the ability to name untrained pictured nouns?

In order to answer the above questions, visual inspection of the data is the primary method being used. The results will be presented individually for each study participant. The number of items named correctly is depicted in **Figures 7, 8 and 9**. Section **(a)** shows responses to Category 1, which was the first qualified group of items submitted to the modified SFA treatment for each participant; section **(b)** shows responses to Category 2, which was the second qualified group of items submitted to the modified SFA treatment for each participant; section **(c)** shows responses to Category 3, which was the third qualified group of items submitted to the modified SFA treatment for each participant; and section **(d)** shows responses to Category 4, which was the fourth qualified group of items for each participant, which was probed but not submitted to SFA treatment.

Participant 1

1) Did training with the Expanding Expression Tool (EET) result in an increase in naming treated pictured nouns? In the baseline phase, four items were named correctly over four consecutive sessions for Category 1 (40% average). During the treatment phase, naming of treated items improved ranging between 6 and 10 items (82% average), meeting mastery criteria for Category 1 within five sessions (Figure 6 (a)). For baseline phase Category 2, naming of items ranged from two to four items (32% average). During the treatment phase, naming of treated items improved to eight items (80% average) over three consecutive sessions meeting mastery criteria for Category 2 within the first three intervention sessions (Figure 6 (b)). For baseline phase Category 3, naming of items ranged from two to three items (21% average). During the treatment phase, naming of treated items improved ranging between six and ten items (81%) meeting mastery criteria for Category 3 within seven sessions (Figure 6 (c)). For Participant 1, the SFA intervention with use of the EET did result in an increase in naming treated pictured nouns.

2) Did training with the EET result in an increase in naming untreated words in the same semantic category as the treated words? In the baseline phase of Category 1, naming of untreated words ranged from three to four items (35% average). During the treatment phase, naming of untreated items also ranged from three to four items (38% average) (Figure 6 (a)). For Category 2, in the baseline phase, naming of untreated words ranged from two to three items (21% average). During the treatment phase, naming of untreated items was four items over three consecutive sessions (40% average) (Figure 6 (b)). For Category 3, in the baseline phase, naming of untreated words ranged from one to four items (30% average). During the treatment phase, naming of untreated items ranged from three to four items (36% average) (Figure 6 (c)). For Categories 1 and 3, training with the SFA and EET did not result in an increase in naming untreated words in the same semantic category as the treated words. For Category 2, there was some generalization with an increase in ability to name untreated words noted during the treatment phase (though not nearly to the level of treated words).

3) Did training with the EET result in an increase in naming untreated words in a different semantic category from the treated words? To answer this question, comparisons were made between the baseline periods of treated items of a category during the time when the previous category was in the treatment phase. During the treatment phase for Category 1 (Sessions 5-8), baselines for Categories 2, 3, and 4 were stable. During the treatment phase for Category 2 (Sessions 10-12), the baseline for Category 3 was stable but the baseline for Category 4 increased (see Sessions 11 and 12 for Category 4). During the treatment phase for Category 3 (Sessions 13-19), the baseline for Category 4 increased. Thus, SFA and EET training did not result in an increase in naming of untreated words across semantic categories for this participant, except in the case of Category 2 (treated) and Category 3 (treated) to Category 4 (untreated words).

Follow-up probes were taken at two and six weeks post-treatment for all 40 items (treated and untreated). At two weeks post-treatment, this participant named items in Category 1 at a level close to the mastery level (70% accuracy); at six weeks post-treatment, maintenance of the treatment effect remained at 70% accuracy. At two weeks post-treatment, this participant named items in Category 2 at a level close to the mastery level (70% accuracy); at six weeks post-treatment, maintenance of the treatment effect slipped to 60% accuracy. At two weeks post-treatment, this participant named items in Category 3 at a level even higher than the mastery level (90% accuracy); at six weeks post-treatment, maintenance of the treatment effect slipped to 60% accuracy. Participant 1 did not consistently maintain the ability to name treated items at treatment-phase accuracy levels, but his ability to name target items during follow-up probes far exceeded performance during the baseline phase.

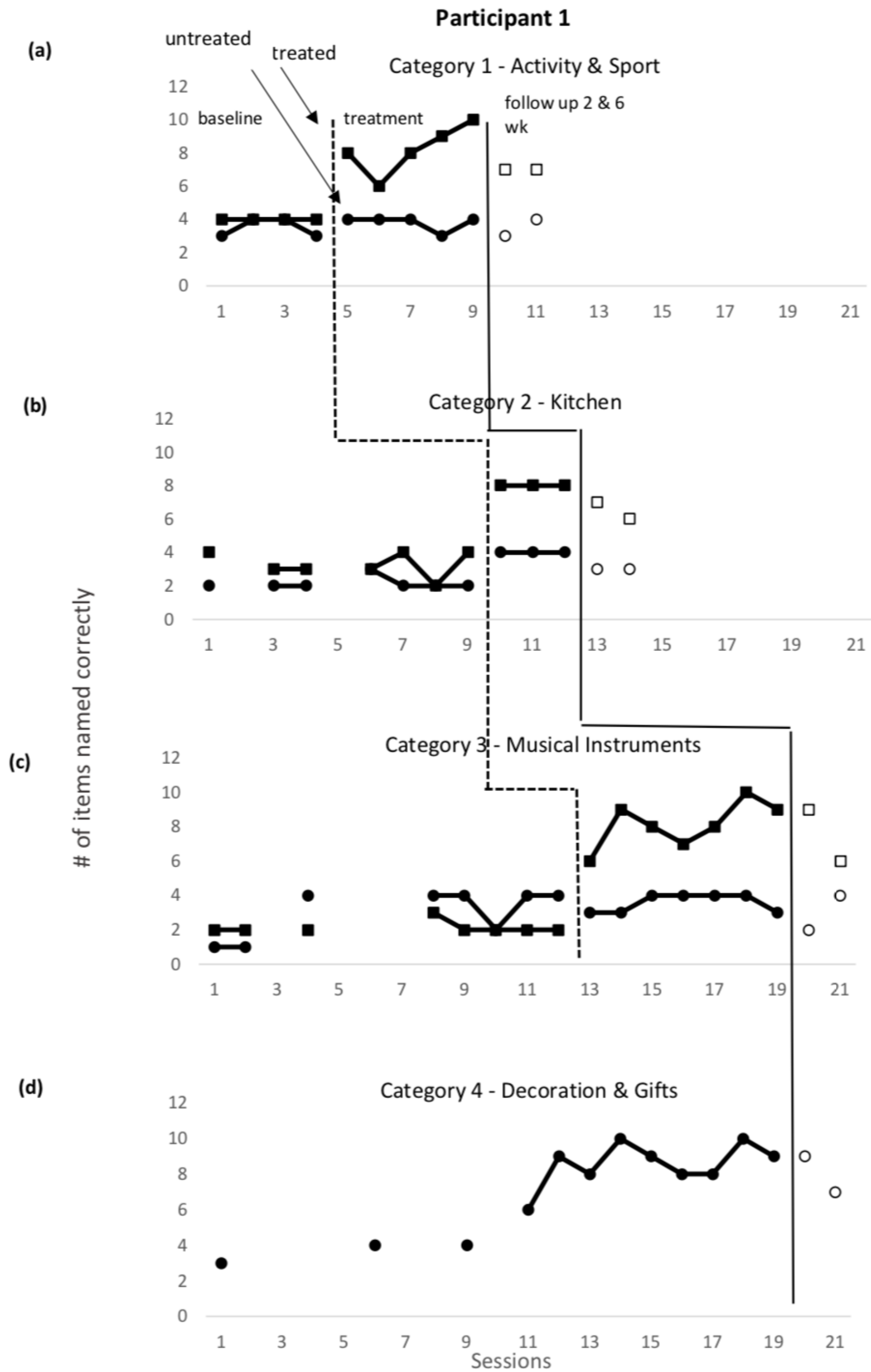


Figure 6: Participant 1 results in baseline, treatment, and two-and six-week follow-up probes. Category 1 is treated in Panel (a), Category 2 is treated in Panel (b), Category 3 is treated in Panel (c), and Category 4 was not treated.

Participant 2

1) Did training with the Expanding Expression Tool (EET) result in an increase in naming treated pictured nouns? In the baseline phase, correct naming of items ranged from zero to four items for Category 1 (24% average). During the treatment phase, naming of treated items improved ranging between three and seven items (49% average). Although the participant did not meet the mastery criterion for this category (80% accuracy over three consecutive sessions) or meet the upper limit of number of sessions, the examiner made the decision to discontinue with this category since the participant had plateaued in amount of improvement and was demonstrating increased levels of frustration (Figure 7 (a)). For baseline phase Category 2, naming of items ranged from one to six items (40% average). During the treatment phase, naming of treated items ranged from four to nine items (72% average), with the participant meeting the mastery criterion for Category 2 within 10 sessions (Figure 7 (b)). For baseline phase Category 3, Participant 2 did not accurately name any items (0%). During the treatment phase, naming of treated items improved ranging between one and six items (38%) over the course of 10 sessions, at which time treatment was discontinued since the participant would not have been able to meet the criterion of eight items correct over three consecutive sessions in 12 sessions (Figure 7 (c)). Although this participant did not meet the mastery criterion of 80% accuracy across three consecutive sessions for two of the semantic categories, SFA intervention with use of the EET did result in an increase in naming treated pictured nouns for all three of the treated categories.

2) Did training with the EET result in an increase in naming untreated words in the same semantic category as the treated words? In the baseline phase of Category 1, naming of untreated words ranged from zero to two (13% average). During the treatment phase, naming of untreated items ranged from one to two items (14% average) (Figure 7 (a)). For Category 2, in the baseline phase, naming of untreated words ranged from one to six items (34% average). During the treatment phase, naming of untreated items ranged from three to six items (41% average). (Figure 7 (b)). For Category 3, in the baseline phase, naming of untreated words ranged from one to two items (19% average). During the treatment phase, naming of untreated items ranged from two to four items (22% average) (Figure 7 (c)). For Participant 2, training with the EET and SFA did not result in an increase in naming untreated words in the same semantic category as the treated words with the exception of a slight average increase for Category 2.

3) Did training with the EET result in an increase in naming untreated words in a different semantic category from the treated words? To answer this question, comparisons were made between the baseline periods of treated items of a category during the time when the previous category was in the treatment phase. During the treatment phase for Category 1 (Sessions 8-14), baselines for Categories 2, 3, and 4 were stable. During the treatment phase for Category 2 (Sessions 15-24), the baseline for Category 3 was stable and the baseline for Category 4 was variable. During the treatment phase for Category 3 (Sessions 25-34), the baseline for Category 4 was variable but never higher than the highest data point (Session 7) when no categories were in the treatment phase. In other words, SFA and EET training did not result in an increase in naming of untreated words across semantic categories for this participant.

Follow-up probes were taken at two and six weeks post-treatment for all 40 items (treated and untreated). Category 1 treated items decreased from 49% average during treatment to 30% average at two weeks post-treatment and decreased further to 20% average at six weeks post-treatment. At two weeks post-treatment, this participant named items in Category 2 at a level close to the mastery level (70% accuracy); at six weeks post-treatment, maintenance of the treatment effect slipped to 60% accuracy. Category 3 treated items decreased from 38% average during treatment to 0% average at two weeks post-treatment and then improved to 20% average at six weeks post-treatment. There was a decline in naming ability at follow-up probes compared to treatment-level performance. Performance on follow-up probes either matched or only slightly exceeded performance at the baseline phase with the exception of Category 2.

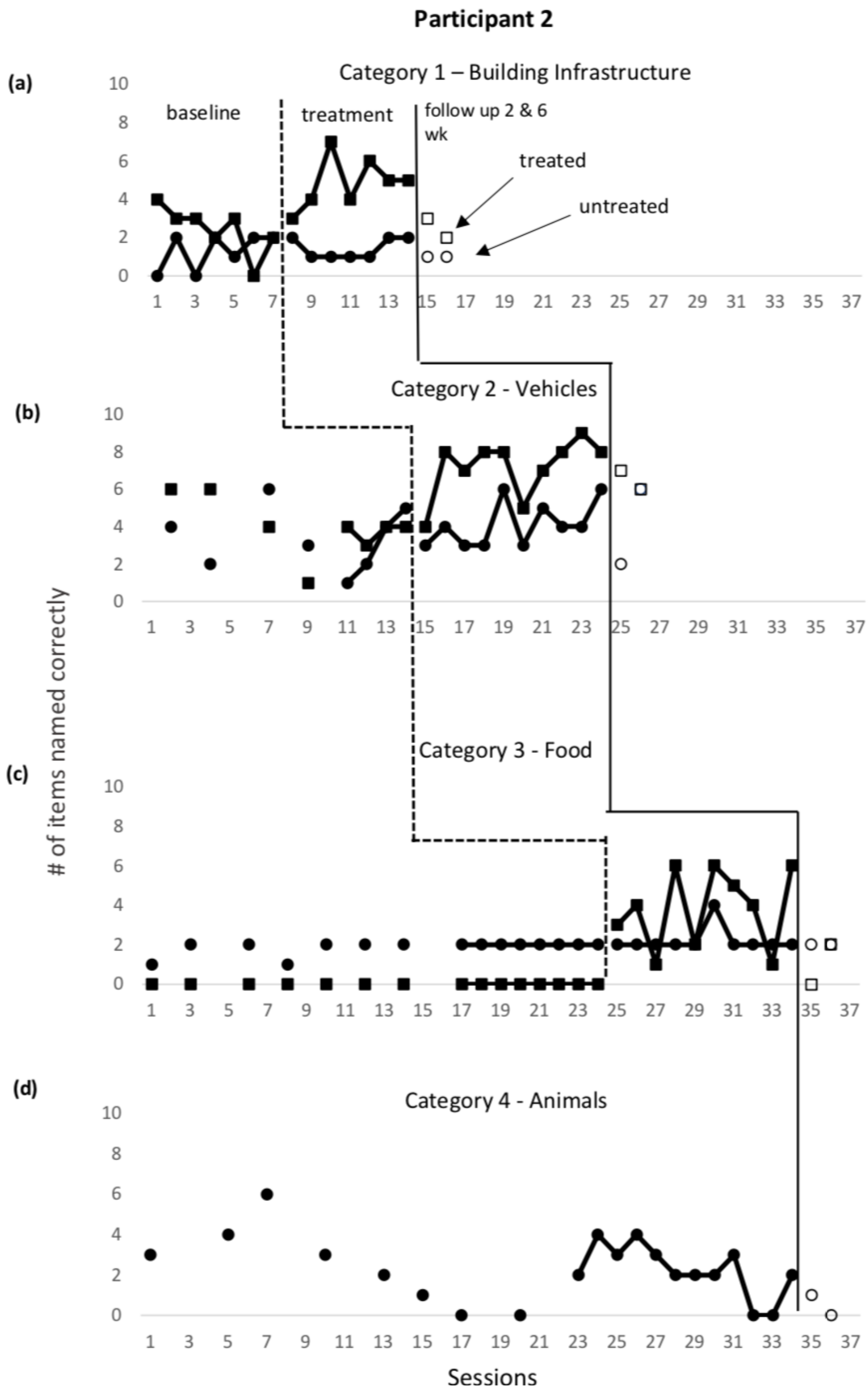


Figure 7: Participant 2 results in baseline, treatment, and two-and six-week follow-up probes. Category 1 is treated in Panel (a), Category 2 is treated in Panel (b), Category 3 is treated in Panel (c), and Category 4 was not treated.

Participant 3

1) Did training with the Expanding Expression Tool (EET) result in an increase in naming treated pictured nouns? In the baseline phase, correct naming of items ranged from one to two items for Category 1 (16% average). During the treatment phase, naming of treated items improved ranging between two and nine items (60% average), and meeting mastery criteria for Category 1 within 10 sessions ((Figure 8 (a)). For baseline phase Category 2, naming of items ranged from zero to two items (11% average). During the treatment phase, naming of treated items ranged from four to eight items (68% average), and the participant met mastery criteria of 80% accuracy over three consecutive sessions within five sessions (Figure 8 (b)). For baseline phase Category 3, Participant 3 did not name any target items at baseline (0%). During the treatment phase, naming of treated items improved drastically, with the participant correctly naming between one and eight items (64%) meeting mastery criteria of three consecutive sessions at 80% naming accuracy for Category 3 within five sessions ((Figure 8 (c)). For Participant 3, the SFA intervention with use of the EET did result in an increase in naming treated pictured nouns.

2) Did training with the EET result in an increase in naming untreated words in the same semantic category as the treated words? In the baseline phase of Category 1, naming of untreated words was zero for Participant 3 (0% average), and during the treatment phase, untreated items remained at 0% accuracy for Category 1 words (Figure 8 (a)). For Category 2, in the baseline phase, naming of untreated words ranged from zero to two items (18% average). During the treatment phase, naming of untreated items ranged from one to two items (18% average) (Figure 8 (b)). For Category 3, in the baseline phase, Participant 3 did not name any untreated words (0%). During the treatment phase, no untreated items were named either (0%

average). These scores are depicted by closed circles and overlap with the squares on Figure 8 (c). For Participant 3, training with the SFA and EET did not result in an increase in naming untreated words in the same semantic category as the treated words.

3) Did training with the EET result in an increase in naming untreated words in a different semantic category from the treated words? Once again, in order to answer this question, comparisons were made between the baseline periods of treated items of a category during the time when the previous category was in the treatment phase. During the treatment phase for Category 1 (Sessions 11-20), baselines for Categories 2, 3, and 4 were stable. During the treatment phase for Category 2 (Sessions 21-25), the baselines for Category 3 and 4 were stable. During the treatment phase for Category 3 (Sessions 26-30), the baseline for Category 4 started to increase. In other words, SFA training for the most part did not result in an increase in naming of untreated words across semantic categories for this participant, with the exception of some generalization from Category 3 treated words to Category 4 untreated words.

As with the previous two participants, follow-up probes were taken at two and six weeks post-treatment for all 40 items (treated and untreated). At two weeks post-treatment, this participant named items in Category 1 at a much lower level than the mastery level (20% accuracy); at six weeks post-treatment, maintenance of the treatment effect rebounded to 60% accuracy. At two weeks post-treatment, this participant named items in Category 2 at a much lower level than the mastery level (20% accuracy); at six weeks post-treatment, maintenance of the treatment remained low at 20% accuracy. At two weeks post-treatment, this participant named items in Category 3 at mastery level (80% accuracy); at six weeks post-treatment, maintenance of the treatment effect remained relatively high at 70% accuracy. This participant did not consistently maintain the ability to name treated items at treatment phase mastery levels.

Maintenance data across the semantic categories were mixed, with Category 1 losing ground at two weeks post-treatment and then recovering to somewhat below the mastery level during the treatment phase but far exceeding the baseline level. Category 2 failed to show maintenance of the treatment effect at two and six weeks post-treatment, and Category 3 maintained the treatment effect at both the post-treatment dates. Since Category 3 was the last category to be treated, it is hypothesized that the treatment effect was maintained at the highest level at two weeks post-treatment and at very close to mastery level at six weeks post-treatment because this category was the closest in time to the collection of post-treatment data. Upon meeting for the six-week follow-up probe, this participant reported that he “studied,” which may account for the increase in naming accuracy for Category 1 items from two weeks post-treatment to six weeks post-treatment.

This study was a single-subject multiple baseline design across both behaviors and subjects. Graphs have been presented so far to illustrate the multiple baseline across behaviors part of the design (Figures 6, 7 and 8 for Participants 1, 2, and 3 respectively). Figure 9 illustrates the multiple baseline across subjects aspect of the study design; this figure shows the Category 1 results for each participant. Results for Participant 1 are represented in Panel (a), results for Participant 2 are represented in Panel (b), and results for Participant 3 are represented in Panel (c). An increasing number of baseline points is seen across the participants, the treatment phase is represented in the center, followed by the two-and six-week follow-up probes.

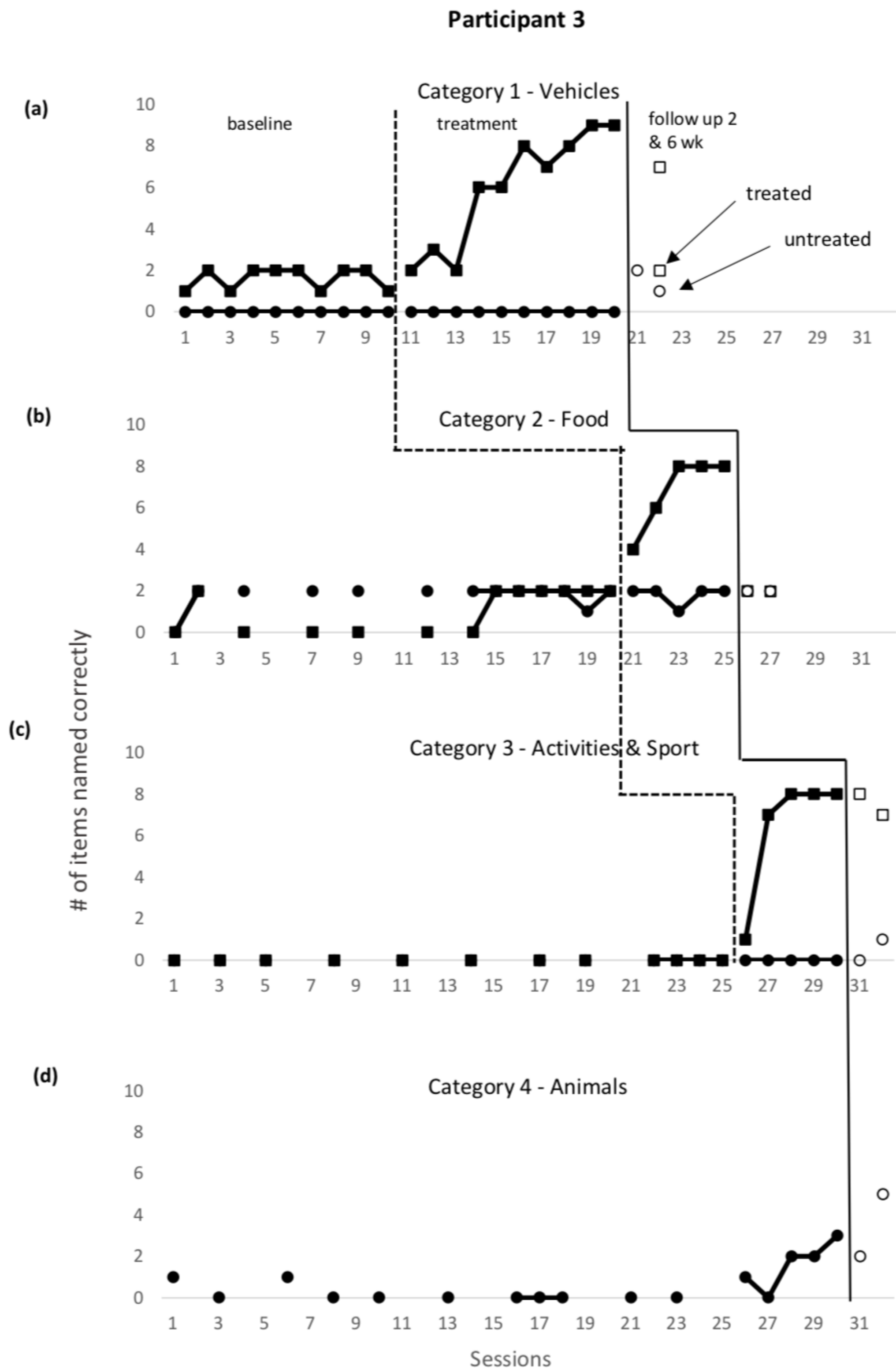


Figure 8: Participant 3 results in baseline, treatment, and two-and six-week follow-up probes. Category 1 is treated in Panel (a), Category 2 is treated in Panel (b), Category 3 is treated in Panel (c), and Category 4 was not treated.

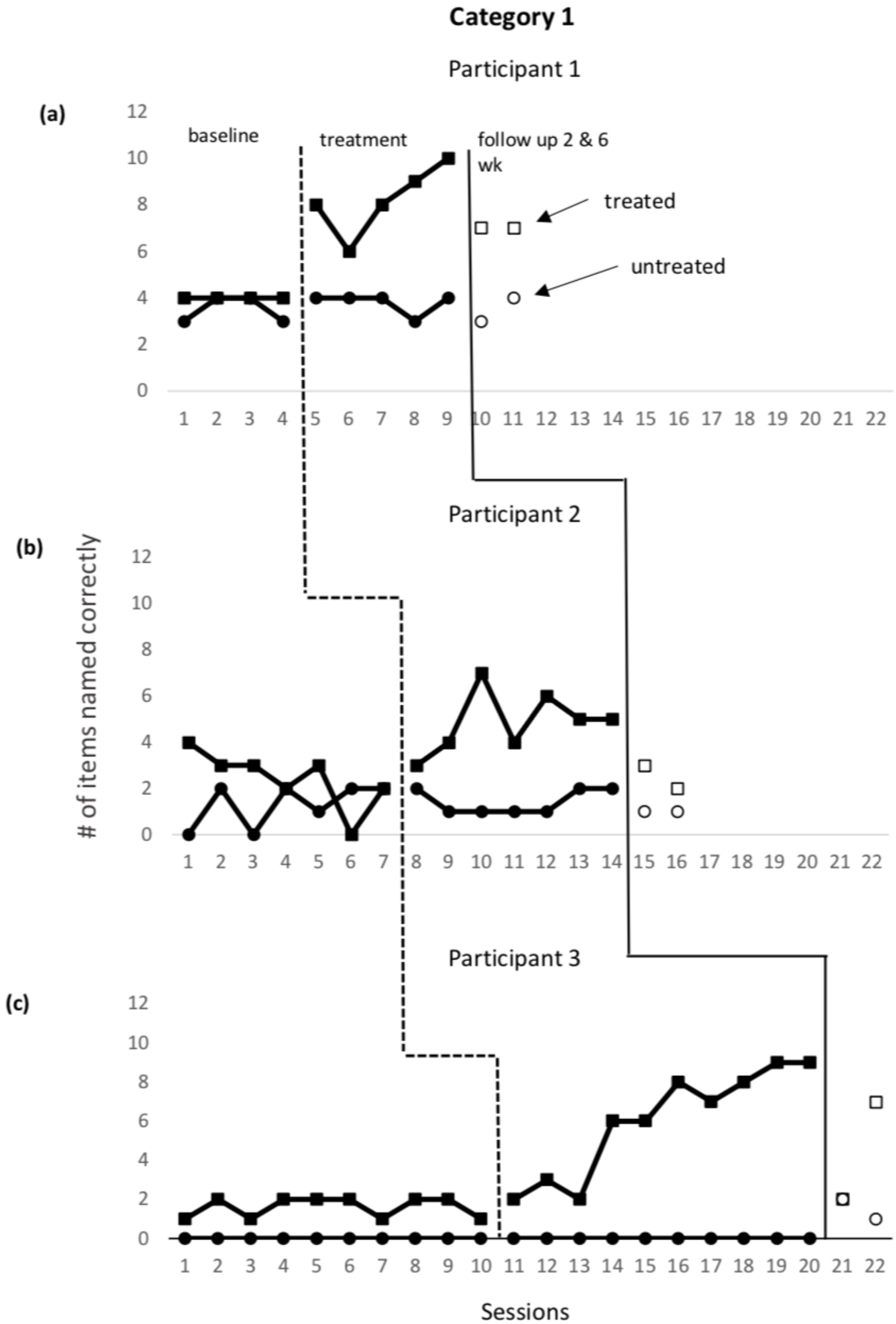


Figure 9: Category 1 results in baseline, treatment, and two-and six-week follow-up probes. Participant 1 is represented in Panel (a), Participant 2 is represented in Panel (b) and Participant 3 is represented in Panel (c).

Post-treatment Standardized Test Results

The results of the pre-and post-treatment assessment results from the Boston Naming Test – 2nd edition (Kaplan et al., 2000) are shown in Table 3. As can be seen in the table, increases in word naming accuracy occurred for all participants, though gains were very modest.

Table 3: Raw score comparison on Boston Naming Test -2 (BNT-2) pre-and post-treatment

	Pre-treatment	**Post-treatment**
Participant 1	51/60	56/60
Participant 2	24/60	28/60
Participant 3	8/60	12/60

Additional Outcomes

The first two secondary outcome measures were to determine 1) whether persons with aphasia would spontaneously use the EET in the context of naming *trained* pictured nouns when experiencing word-finding difficulty and 2) whether they would spontaneously use the EET in the context of naming *untrained* pictured nouns when experiencing word-finding difficulty. Although Participant 1 reached for the EET strand during intervention sessions, at no point did this participant access the strand of beads during the naming probes. Participant 2 did not independently use the EET beads during the intervention despite encouragement throughout treatment sessions. Similar to Participant 1, Participant 3 did not spontaneously use the strand of beads during naming probes despite their accessibility. In terms of the number of semantic features produced by the person with aphasia during training sessions, there was some relation between ability to name semantic features independently within a session and success with total naming of treated probe items at the end of a session. See Table 4 for averages.

Table 4: Percentages of treated and untreated pictured nouns named during the treatment phase for each category for each participant compared to number of semantic features produced independently per category.

Participant	**Named treated pictured nouns (average)**	**Named untreated pictured nouns (average)**	**Average # semantic features produced independently/ category (total/#sessions)**
Participant 1 – Category 1	82%	38%	21.6
Participant 1 – Category 3	81%	36%	17.7
Participant 1 – Category 2	80%	40%	17.7
Participant 2 – Category 2	72%	41%	16.6
Participant 3 – Category 2	68%	18%	11.6
Participant 3 – Category 3	64%	0%	12.4
Participant 3 – Category 1	60%	0%	10.1
Participant 2 – Category 1	49%	14%	13.4
Participant 2 – Category 3	38%	22%	12

In Table 4 presented above, information is ordered based on the last column in order to highlight the relation between the average number of semantic features produced independently per category and the number of named pictured nouns. As can be seen from Table 4, the number of semantic features produced independently appeared to be related to ability to produce treated and untreated pictured nouns for all participants – the stronger a person's ability to name semantic features, the higher the probability one would name the treated and untreated items. Participant 1 produced the highest number of semantic features independently across all categories and named the most items (both treated and untreated). Participant 3 produced the lowest number of semantic features independently during treatment sessions but was still able to name treated picture items with moderate levels of success (and met mastery criteria for all three semantic categories).

In terms of the independent production of semantic features, the following patterns emerged. For Participant 1, "white where" was the semantic feature produced independently the most often (4.1 average), followed by "green group" (3.4), "blue do" and "what else do I know"

(2.93). For Participant 2, “blue do” was the semantic feature produced independently the most often (2.9), followed by “green group” (2.6) and “made of” (2.3). For Participant 3, “blue do” was the semantic feature produced independently the most often (3.6), followed by “made of” and “white where” (1.75). “What does it look like” and “pink parts” were not in the top three independently produced semantic feature categories for any of the participants.

Participants 1 and 3 exhibited relatively consistent errors throughout the intervention, making errors on the same word until that word was mastered (e.g., Participant 1 was consistently unable to name ‘cake platter’). Participant 2 had slight variability from one session to the next in the errors he made (e.g., correctly naming ‘kiwi’ on one trial, then not on the next, then missing it on both trials the next session date, then correctly naming it on one of two trials and so on).

Some target items were longer in length, in number of syllables, or were actually two words in length. This did not appear to have an effect on Participant 1’s ability to name items (e.g., able to learn target items “salad spinner,” “muffin tray,” “serving spoon,” but unable to name “cake platter”). Participant 2 (who had moderate Broca’s aphasia) was also able to successfully name treated words that were longer in length, multisyllabic, or compound as evidenced by his success with treated words for Category 2 (e.g., wheelchair, sailboat, helicopter, shopping cart). These words were more complex in terms of structure than his target words for Category 1 or 3 (examples which include “dumpster,” “bread,” and “kiwi”), but this participant met mastery criterion for Category 2 and not for Categories 1 or 3. Participant 3 exhibited a similar pattern, with no indication that word length, syllable count, or phonemic complexity had an impact on ability to name items.

Chapter 5: Discussion

Word-finding impairments are one of the hallmark characteristics of aphasia and are known to remain months and even years after a stroke. These deficits can lead to breakdowns in communication and decrease independence for this population. While there is a strong research base to support the use of Semantic Feature Analysis (SFA) grounded in current theories of word retrieval for persons with aphasia, there is limited information available regarding its success as an intervention that is delivered remotely. There is also a lack of information regarding the use of self-cueing strategies to help facilitate word-finding using SFA. While there have been modifications made to SFA in past studies including use of typical and atypical exemplars in semantic categories (e.g., “kiwi” and “apple”), slight modifications to the SFA chart, targeting of verbs etc., the modifications explored in previous studies have yielded similar results: positive outcomes for treatment of target words, with limited generalization to untreated words (Maddy, Capilouto, & McComas, 2014). Self-cueing strategies provide an avenue for optimizing the use of SFA so that strategies can be implemented independently and generalization can occur.

Outcomes and Clinical Implications

This is the first study to have implemented the use the Expanding Expression Tool (EET) with an adult population and the only known study to fully implement a modified Semantic Feature Analysis (SFA) intervention remotely. The ability to self-cue is a critical component in the ability to generalize learning to additional contexts beyond treated words and the clinical intervention session – a component that is lacking in the area of SFA.

The EET provides a tactile and visual cue that is permanent (much like a written word). For these reasons, access to such a tool could potentially help with generalization that is lacking in SFA treatment alone. Although this is the first study to explore use of the EET, there is evidence from the word-naming literature to support that providing orthographic cues as well as feedback on accuracy of naming is helpful for word-finding. These visual cues provide permanence, so that the person with aphasia does not have to rely on additional auditory language (Sze, Hameau, Warren, & Best, 2020). If mastered, the EET strand could provide a novel avenue for self-cueing that could generalize to any word or context.

As in previous studies, naming abilities increased in all semantic categories from baseline to treatment phases for all participants during this study. In other words, training with the EET using SFA did result in an increase in naming treated pictured nouns. This is a critical finding with important clinical implications. Although we know that SFA is a successful treatment for noun word-naming, the finding that a modified SFA intervention can be successfully implemented via an entirely remote platform is of tremendous importance to the field. Within the population of persons with aphasia, we are often serving individuals who are elderly or who may not be able to drive (sometimes due to stroke-related impairment). As such, transportation is commonly a barrier to receiving intervention services. Persons who live in rural areas also are often underserved for this reason, as are those who are elderly and do not want exposure to illness (in this case, all in-person interventions were suspended due to COVID-19). Confirmation that remote applications of SFA are successful could help to reduce service barriers for some persons with aphasia.

In terms of overall performance, two of three subjects reached mastery criterion for naming treated pictured nouns. Participant 2 did not meet mastery criterion in two of the three semantic categories; this participant experienced higher levels of frustration than the other two participants throughout the intervention study, which could visibly be seen via his mannerisms during certain sessions. He also voiced his frustrations about his language deficits, asking why the language deficits hadn't resolved after his stroke (as they had after a previous transient ischemic attack that he had prior to the stroke resulting in aphasia). When frustration levels were noted to be escalating, this participant was provided with the options of taking breaks, ending sessions early and resuming at a later time, and also withdrawing from the study, but this participant did not choose these options. Even though frustration levels appear to have had a negative impact on performance (with lower naming scores on days when increased frustration was noted) and this participant did not meet mastery criterion in two of three semantic categories, this participant used more descriptions of semantic features during probes as the treatment progressed.

Even though EET training was minimal (see Limitations section), there was some generalization from treated to untreated words in the same semantic category and across semantic categories to untrained words for Participant 1 (within Category 2 untrained words see Figure 7b; and across categories from Category 2 to Category 4 and from Category 3 to Category 4 - see Figure 7d), and Participant 3 (from Category 3 to Category 4). Participant 1 demonstrated the highest level of independence with the use of the EET strand and used self-cueing strategies throughout treatment, often picking up the EET strand and manipulating the beads across the strand while describing the pictured nouns throughout treatment. Participant 1 also independently produced the highest number of semantic features per item (Table 4). This greater independence of EET strand use and semantic feature descriptions could both be contributing factors to Participant 1 demonstrating some generalization of naming skills to untreated items as compared to Participant 2 and 3. Although Participant 1 used the EET strand the most during the treatment sessions, he did not implement its use during the naming probes. During a follow-up interview, when asked if he used the beads over the 2-week period, the participant stated that he had not, but did not elaborate why he had not implemented their use. It is possible that the timed nature of the treatment probes was a deterrent to using the EET strand. Another possibility is that the participant did not have the executive functioning or awareness skills to generalize use of the EET strand beyond the intervention to the probes or to other aspects of his life. It could also be that this participant (with Anomic aphasia) felt that his naming deficits were not severe enough to warrant the use of the EET strand.

Participant 3 reported that he studied in between sessions, which may have contributed to his generalization from the treated to untreated items from Category 3 to Category 4. In order to maximize generalization for other participants, additional avenues to explore could include: development of protocols for more explicit teaching of the EET strand and manipulation of the types of words chosen (choose target words that are patient-centered and have more personal relevance to the client).

In terms of maintenance of naming treated items at two and six weeks post-intervention, there was some maintenance of skills across all three participants, although performance did not maintain to the level of the treatment effect. Accuracy levels at six-week follow-up probes dropped most of the time for treated items compared to the two-week post-intervention for all participants except Participant 2 who named fewer items at the two-week probe (0%) than at the six-week probe (20%) for Category 3. In fact, Participant 2 did not maintain the ability to name treated items at treatment-phase accuracy levels for two of the three semantic categories (Category 1 and Category 3), and naming accuracy fell to (or close to) baseline levels for both of these categories. It is unclear why this participant did not maintain performance or scored more poorly at two weeks compared to six weeks post-treatment, but we can generate some hypotheses based on the literature in other areas of aphasia research. Participants are more motivated to preform and generally have better outcomes when interventions are patient-centered and geared toward their interests (Palmer, Enderby & Paterson, 2013). Perhaps Category 1 or Category 3 was not of high interest to this participant. Future studies could explore this facet to determine whether participants can more readily name words from high-vs. low-interest categories. Using a resource such as the Life Interests and Values (L!V) cards (Haley, Womack, Helm-Estabrooks, Caignon, & McCulloch, 2010) to select activities that the participant wanted to engage in, and selecting target words that would be used during those activities may have been helpful. Additionally, Participant 2 did not meet the mastery criterion of 80% accuracy across three consecutive sessions during the SFA with EET intervention for the two categories whose treatment effect was not maintained. In terms of clinical implications, these results suggest that if persons with aphasia do not meet mastery criterion of at least 80% accuracy over three consecutive sessions during the treatment stage of this SFA with EET intervention, this could result in poor maintenance of naming skills. Participant 2 did exhibit a significant increase in his descriptions of target items as compared to baseline (despite not being able to produce the target name within the allotted time during probes).

When comparing pre-and post-treatment test results on the Boston Naming Test-2 (BNT-2, Kaplan et al., 2000), all three participant's scores did improve (Table 3). The score on the BNT-2 for Participant 1 fell within the normal range both pre-and post-treatment. BNT-2 score for Participant 2 improved half a standard deviation (from 4 SDs below the mean to 3.5 SDs below the mean), and Participant 3 improved half a standard deviation (from 6.5 SDs below the mean to 6SDs below the mean). One of the new words named in post-treatment BNT testing for Participant 3 belonged to target semantic Category 3.

When considering who may be an appropriate candidate for a remote SFA and EET intervention, initial performance (represented by baseline scores in this case) may not be a strong indicator of how an individual may perform in therapy. First, all three participants demonstrated increased naming abilities for treated words in all categories. Looking specifically at Participant 3 for Category 3 (Figure 9c), this participant remained at 0% naming accuracy for both treated and untreated words throughout baseline sessions. Once treatment began, this participant's ability to name items within this category increased drastically after treatment Session 2, with this participant meeting mastery level criteria of 80% accuracy over three consecutive sessions within only five sessions.

Participants with three types of aphasia were represented in this study including Anomic, Broca's, and Conduction aphasia, with severity levels ranging from mild to moderate (Table 2). As previously stated, all three participants did show an increase in naming ability in all semantic categories from the baseline to the treatment phase. It stands to reason, then, that this SFA and EET treatment delivered via a remote model could be appropriate for other persons with similar aphasia profiles (mild to moderate Anomic, Broca's, or Conduction aphasia). However, Participant 1 (who had mild, Anomic aphasia) demonstrated the most consistent treatment effects and met criterion the fastest (Category 1 – mastery level criterion met in five sessions, Category 2 – mastery level criterion met in three sessions, Category 3 – mastery level criterion met in seven sessions). This could have been due to his stronger overall language skills. In fact, in their review about the impact of semantic feature types on naming ability, Evans et al. (2020) found that although the diversity of the features generated did not translate to better naming accuracy, severity level of the aphasia did in fact play a big role in treatment outcome when implementing SFA, with persons with severe aphasia being less likely to demonstrate gains than those with mild aphasia. It is possible that the more severe a person's aphasia, the more difficult it is for that person to generate semantic features independently, which may in turn result in poor naming as was seen in the current study.

Intervention time (both length of treatment session and number of intervention sessions to reach mastery criteria) for the study varied slightly by participant but was in line with what was found in previous studies (Quique, Evans, & Dickey, 2019). Participant 1 had the highest Western Aphasia Battery – Revised (WAB-R; Kertesz, 2007) Aphasia Quotient (AQ) score (82) and reached levels of mastery the fastest. Participants 2 and 3 had comparable WAB-R AQ scores (62.2 and 60.9, respectively). Participant 2, who had Broca's aphasia, did exhibit some apraxia of speech (AOS) and was far less fluent in his speech than Participant 3. In a previous study about SFA and persons with both aphasia and AOS that compared intensity of treatment, the results suggested that the presence of a motor speech disorder did not have an impact on one's response to SFA treatment or the time needed to make maximum gains with therapy (Scholl, McCabe, Nickels, & Ballard, 2021). With a small sample size and only one participant with a motor speech disorder, it is difficult to discern whether a motor speech disorder was a contributing factor to the outcome of this SFA plus EET treatment (and the initial repetition/learning aspect of the EET strand). Participant 2 was the only participant with a non-fluent aphasia and had less expressive language output than Participant 1 or Participant 3. This may have contributed to difficulties with his ability to independently produce semantic features using the EET strand during the intervention or name target items during probes.

Some changes were made to the administration of the standardized tests due to the remote format of the study. The assessments used (WAB-R; Kertesz, 2007, BNT-2nd edition; Kaplan et al., 2000, and the Pyramids and Palm Trees Test; Howard & Patterson, 1992) were not originally designed to be administered via computer. Additionally, caregivers or family members assisted with the administration of these measures. There has been one study regarding the WAB-R which does support that administration via videoconference may be used interchangeably with in-person administration. However; to ensure validity of results, the set-up in that study was slightly different with test stimuli scanned and shared with participants via computer screen, and assistance from caregivers or family members only for videoconference set-up and not with actual administration of test items (Dekhtyar, Braun, Billot, Foo, & Kiran, 2019).

There were some subjective observations that have clinical implications for this type of treatment. Participant personality and motivation may contribute to outcomes for SFA and EET intervention. As noted above, there were instances during the study in which Participant 2 became highly frustrated and these days resulted in probe session days with lower overall scores. Participant 2 also expressed that he did not see the value in the use of the EET strand (and thus did not access it throughout the study, but rather watched the researcher's use of the strand). A word of caution regarding the concept of motivation: it is the role of the clinician to provide value and to motivate the participant. If the participant is not motivated by the activity, modifications on the part of the clinician or researcher to the activity should be made. Words that were of more personal relevance could have been chosen and may have provided more 'value' to this participant for example. Participant 1 was the most active with the EET strand and could be heard independently manipulating the beads across the EET strand and referring to the EET chart during intervention sessions (though this self-cueing did not occur during naming probes). Participant 3 fell between these two participants in terms of EET strand use, but was self-motivated in other ways, often reporting that he "studied" in between intervention sessions (this participant would occasionally research information and learn facts about a particular target item). These observations highlight the importance of buy-in and motivation for any clinical intervention and a failure on the part of the researcher to design a study with enough scaffolding to explicitly instruct the use of the strand to all participants.

Although Participant 2 did not meet the mastery level criteria of 80% accuracy over three consecutive session days for two of three categories and failed to maintain treatment progress in those same two categories (the primary outcomes for this study), there were other promising and clinically meaningful changes in this participant's language abilities. Specifically, even though this participant was unable to name target words during the allotted time during probes, he was noted to use much more specific language to describe the target item. For example, at the beginning of treatment for the target word "barn," he described it as a 'farm box', and at the six-week follow-up probe it was described as 'a building, red, a farm, like a shed, for animals.' Although the target word was not elicited, the participant was able to provide a far more thorough description of the item at follow-up than he was initially. This is a practical strategy for an individual with aphasia to implement when experiencing word- finding difficulties and unable to retrieve a specific word. This type of strategy can help to maintain the flow of conversation or help to repair a communication breakdown. This type of spontaneous language use could be quantified in future studies through the counting of correct information units (CIU's) (Nicholas & Brookshire, 1993).

As previously noted, generalization, whether it be to untrained items, different settings, or otherwise, has long-been the most challenging hurdle experienced with word-finding treatments for persons with aphasia. In a previous study by Kendall, Moldestad, Allen, Torrence, and Nadeau, SFA and phonomotor treatments were compared to target anomia in a randomized control trial. Neither group demonstrated generalization to untrained words or meaningful change in everyday life (Kendall et al., 2019). There was some evidence of meaningful change in everyday life in the current study. There were subjective reports from a clinician and a family member that Participant 2 was contributing more when participating in group aphasia therapy sessions (after the intervention study had ended) and was using more descriptions in his speech. When asked about this increase in oral language expression, the family member and participant reported that he had learned the strategy of producing richer descriptions during the EET and SFA study. During a follow-up call, this family member mentioned again that this participant's speech-language pathologist noted an increase in his speech, and both the family member and the participant attributed it directly to strategies learned during this intervention study. Unlike findings found in the Kendall et al. study, these anecdotal reports suggest generalization beyond the research study. This generalization beyond the study also could be attributed to other factors such as responsiveness of communication partners (Harmon, Jacks, Haley, & Bailliard, 2019).

Limitations

Although the current study yielded positive results (there was a treatment effect and the treatment effect was often maintained post-treatment) and insight was gained regarding remote intervention using Semantic Feature Analysis, there were several modifications made to the study due to COVID-19 study changes that limited its original aim (See Appendix H). Despite the tactile EET strand being taught to the participants and it being available to them during probes, a lack of interaction and instruction between the researcher and participant with the EET strand may have resulted in less use of the EET strand throughout the intervention study than originally anticipated. It is possible that more systematic instruction in the use and manipulation of the EET strand is needed in order to encourage its use.

The current study was limited in sample size, such that future studies are needed to confirm these findings. Additionally, all three participants were of the same race, ethnicity, and gender. As this is not representative of the population as a whole, results may not be generalizable to all persons with aphasia. Additionally, although three different aphasia types were represented (Anomic, Broca's, and Conduction), all three participants had mild to moderate aphasia as demonstrated by their aphasia quotients; thus, results cannot be generalized to persons with severe or very severe aphasia.

Another potential limitation of the study was the remote administration of standardized assessments that are not validated for remote administration; furthermore, these standardized assessments were administered with the assistance of a family member and/or a caregiver. As noted in the Methods section, family members/caregivers assisted by holding up items up for the participant, locating and turning pages, reading items to the participant as needed, etc. These departures from examiner-administered in-person assessments may have had some impact on assessment results since these measures are not standardized for remote administration and there was some divergence from protocol. For example, on at least three testing questions, a family member/caregiver increased the volume of her voice when reading a correct answer from a multiple-choice item on the Boston Naming Test-2 (Kaplan et al., 2000).

The intention was to see participants without any family members or others present for treatment sessions, which was typically the case; however, occasionally there were persons in the background in the same room or off camera (not interacting) or in an adjacent room listening to the session who would occasionally make comments or insert themselves during the treatment session. Additionally, there was less environmental control than there would be in a typical research setting, so occasionally, there was some competing background noise to contend with (i.e., a delivery to the home during the session, television on in an adjacent room, etc.).

Due to limitations related to technology, video recording was not available during the course of this intervention study. As a result, treatment fidelity checks were not completed, and reliability data were not taken. Before the IRB-mandated change from in-person to remote data collection, assessing inter-rater reliability was part of the research study plan. Since the Zoom Healthcare platform did not allow for recording and screen-sharing at the same time on an iPad, it was not possible to collect reliability data from recorded sessions. It is possible to have taken real-time reliability data remotely, with another researcher watching some of the remote sessions; with all of the COVID-19 modifications, this ideal alternate to taking reliability data from recorded sessions did not occur. Additionally, set-up was not always ideal, and video camera angles made it difficult to see when participants were picking up or holding the EET strand.

Future Directions

Future research efforts using the Expanding Expression Tool as applied to SFA intervention could include a more structured protocol for systematic teaching of the EET strand throughout intervention. This could promote use of the tool, thereby increasing generalization to untrained items. Since there was some generalization of strategy use beginning to emerge beyond the research setting (as indicated by family member and SLP report), additional emphasis on use of the strand could help to promote this generalization beyond the research setting.

Future studies could explore whether this type of modified remote intervention can be applied to additional word types – adjectives or verbs, for example. Research using SFA for verb retrieval is more limited (see previous research from Wambaugh & Ferguson, 2007), but if successful, this would greatly expand the vocabulary to which the individual with aphasia would have access.

To increase the efficiency of the current intervention, an avenue to explore is to reduce the number of semantic features targeted – in other words, to modify the EET strand to reduce the number of balls on the EET strand. Participants in this study had a difficult time discerning the difference between “look like” (size, shape, color) and “pink parts” and would often describe visual features of the target item for each during the intervention. Combining these into one semantic category that covered the visual description of the item would help to simplify the intervention. When compared to the others, the orange ball, “What else do I know,” proved challenging for participants as well, likely due to the abstract nature of this semantic feature. Eliminating these two semantic categories from the EET strand could help to increase the efficiency of the intervention.

An additional avenue to explore in future studies is a comparison of word types. While this study used criteria of visual complexity and familiarity ratings from a standardized picture bank to select stimuli, one might explore how a participant with aphasia would be more or less apt to name items that were in high-vs. low-interest categories to them since the issue of motivation did seem to play a role in the success of the participants.

Another area of future study is to go beyond the word level to explore implementation of the SFA and EET. Use of the tactile and semantic nature of the EET strand could be used for facilitation of word-retrieval during sentence tasks or at the discourse level. Due to the self-cueing nature of the EET strand, this strategy also may lend itself to studies within an aphasia conversation group setting to determine whether group participation (comments, etc.) increased after training with EET and when participants had access to their EET strands.

Finally, future studies would address methodological flaws and limitations in implementation noted above. Of note, this would include a larger sample size, a more diverse participant sample, assistance to participants with camera angles and initial set-up for optimal session-viewing, increased environmental control, and video recording for fidelity and reliability checks.

Conclusions

The primary purpose of this study was to determine whether participants with aphasia would improve their word naming of pictured nouns via a Semantic Feature Analysis intervention complemented with use of the Expanding Expression Tool (EET). The findings of this study are certainly preliminary and require additional investigation with additional subjects and more explicit and systematic teaching of the EET. However, based on results of this study, the Expanding Expression Tool shows promise for training word naming of pictured nouns. Another contribution to the existing SFA body of research literature is that it was discovered that this modified Semantic Feature Analysis intervention can be implemented via remote delivery and yield positive results.

References

Antonucci, S. (2009). Use of semantic feature analysis in group aphasia treatment. *Aphasiology, 23(7-8),* 854-866. doi.org/10.1080/02687030802634405

Boyle, M. (2004). Semantic feature analysis treatment for anomia in two fluent aphasia syndromes. *American Journal of Speech-Language Pathology, 13,* 236–249. doi:10.1044/1058-0360(2004/025)

Boyle, M. (2010). Semantic Feature Analysis treatment for aphasic word retrieval impairments: What's in a name? *Topics in Stroke Rehabilitation*, *17*(6), 411–422. doi: 10.1310/tsr1706-411

Boyle, M., & Coelho, C. A. (1995). Application of semantic feature analysis as a treatment for aphasic dysnomia. *American Journal of Speech-Language Pathology, 4,* 94–98. doi.org/10.1044/1058-0360.0404.94

Brandt, P. (2008, April). Bay City elementary students have a ball learning. *The Bay City Times.*

Brodeur, M., Guerard K., & Bouras, M. (2014). Bank of Standardized Stimuli (BOSS) Phase II: 930 New Normative Photos. *PLoS One*, *9(9),* 1-10. doi.org/10.1371/journal.pone.0106953

Centers for Disease Control and Prevention (CDC) (n.d.). Stroke Facts. Retrieved January 12, 2019, from website: https://www.cdc.gov/stroke/facts.htm.

Davis, A. (2005). PACE revisited. *Aphasiology*, 19(1), 21–38. doi.org/10.1080/02687030444000598

Dekhtyar, M., Braun, E.J., Billot, A., Foo, L., & Kiran, S. (2020). Videoconference administration of the Western Aphasia Battery–Revised: Feasibility and validity. *American Journal of Speech–Language Pathology, 29 (2),* 673-687. doi.org/10.1044/2019_AJSLP-19-00023

Dell, G., & O'Seaghdha, P. (1992). Stages of lexical access in language production. *Cognition, 42 (1-3),* 287-314. doi.org/10.1016/0010-0277(92)90046-K

DeWeerd, M. J., & McCann, S. (n.d.). Using the Expanding Expression Tool (EET) as a method for improving detail in second grade students writing (unpublished report). Hudsonville Christian School, Hudsonville, MI.

Evans, W., Cavanaugh, R., Gravier, M., Autenreith, A., Doyle, P., Hula, W., & Walsh Dickey, M. (2020). Effects of semantic feature type, diversity, and quantity on semantic feature analysis treatment outcomes in aphasia. *American Journal of Speech–Language Pathology, 3 (1),* 344-358. doi.org/10.1044/2020_AJSLP-19-00112

Falconer, C., & Antonucci, S. M. (2012). Use of semantic feature analysis in group discourse treatment for aphasia: Extension and expansion. *Aphasiology, 26(1),* 64–82. doi.org/10.1080/02687038.2011.602390

Goodglass, H. (1980). Disorders of naming following brain injury: Observation of the effects of brain injury adds another dimension to our understanding of the relations between neurological and psychological factors in the naming process. *American Scientist, 68 (6),* 647-655. https://www.jstor.org/stable/27850133

Haarbauer-Krupa, J., Moser, L., Smith, G., Sullivan, D. M., & Szekeres, S. F. (1985a). Cognitive rehabilitation therapy: Middle stages of recovery. In M. Ylvisaker (Ed.), *Head injury rehabilitation: Children and adolescents* (pp. 287–310). San Diego, CA: College-Hill Press.

Haley, K. L., Womack, J. L., Helm-Estabrooks, N., Caignon, D., & McCulloch, K.L., (2010). *The Life Interests and Values Cards*. Chapel Hill, NC: University of North Carolina. Department of Allied Health Sciences.

Harmon, T.G., Jacks, A., Haley, K.L., & Bailliard, A. (2019). How responsiveness from a communication partner affects story retell in aphasia: Quantitative and qualitative findings. *American Journal of Speech–Language Pathology*, *29 (1),* 142-156. doi.org/10.1044/2019_AJSLP-19-0091

Hashimoto, N. (2012). The use of semantic- and phonological-based feature approaches to treat naming deficits in aphasia. *Clinical Linguistics & Phonetics, 26,* 518–533. doi.org/10.3109/02699206.2012.663051

Howard, D., & Patterson, K. E. (1992). *The Pyramids and Palm Trees Test*: *A Test of Semantic Access From Words and Pictures.* London, UK: Thames Valley Test Company.

Kendall, D., Moldestad, M., Allen, W., Torrence, J., & Nadeau S. (2019). Phonomotor versus semantic feature analysis treatment for anomia in 58 persons with aphasia: A randomized controlled trial. *Journal of Speech, Language, and Hearing Research*, *62 (12).* 4462-4482. doi.org/10.1044/2019_JSLHR-L-18-0257

Kaplan, E., Goodglass, H., & Weintraub, S. (2000). *Boston Naming Test-2*. Philadelphia: Lea & Febiger.

Kertesz, A. (1982). *Western Aphasia Battery.* New York (NY): Grune & Stratton.

Kertesz, A. (2007). *Western Aphasia Battery- Revised.* New York (NY): Grune & Stratton.

Knoph, M., Lind, M., & Simonsen, H. (2015). Semantic feature analysis targeting verbs in a quadrilingual speaker with aphasia. *Aphasiology, 29 (12),* 1473-1496. doi.org/10.1080/02687038.2015.1049583

Kristensson, J., Behrns, I., & Saldert, C. (2015). Effects on communication from intensive treatment with semantic feature analysis in aphasia. *Aphasiology, 29(4),* 466–487. doi.org/10.1080/02687038.2014.973359

Laiacona, M., Luzzatti, C., Zonca, G., Guarnaschelli, C., & Capitani, E. (2001). Lexical and semantic factors influencing picture naming in aphasia. *Brain and Cognition, 46 (1)* 184-187. doi.org/10.1016/S0278-2626(01)80061-0

Laine, M., & Martin, N. (1996). Lexical retrieval deficit in picture naming: Implications for word production models. *Brain and Language, 53,* 283–314. doi.org/10.1006/brln.1996.0050

Levelt, W. J. M. (1999). Models of word production. *Trends in Cognitive Sciences, 3,* 223–232. doi.org/10.1016/S1364-6613(99)01319-4

Long, A. F., Hesketh, A., Paszek, G., Booth, M., & Bowen, A. (2008). Development of a reliable self-report outcome measure for pragmatic trials of communication therapy following stroke: The Communication Outcome after Stroke (COAST) scale. *Clinical Rehabilitation, 22,* 1083–1094. doi.org/10.1177/0269215508090091

Maddy, K., Capilouto, G., McComas, K., (2014). The effectiveness of semantic feature analysis: An evidence-based systematic review. *Annals of Physical and Rehabilitation Medicine, 57,* 254-267. doi.org/10.1016/j.rehab.2014.03.002

Marcotte, K., & Ansaldo, A. I. (2010). The neural correlates of semantic feature analysis in chronic aphasia: Discordant patterns according to the etiology. *Seminars in Speech and Language.* Specials Issue on Treatment of Chronic Aphasia: International Perspectives, *31(1),* 52–63. doi: 10.1055/s-0029-1244953

National Aphasia Association (n.d.). What is Aphasia. Retrieved January 12, 2019, from website: https://www.aphasia.org.

National Institute on Deafness and Other Communication Disorders (NIDCD) (n.d.). Aphasia. Retrieved January 12, 2019, website: https://www.nidcd.nih.gov/health/aphasia

Neumann, Y. (2018). A case series comparison of semantically focused vs. phonologically focused cued naming treatment in aphasia. *Clinical Linguistics & Phonetics, 32(1),* 1–27. doi.org/10.1080/02699206.2017.1326166

Nicholas, L. & Brookshire, H. (1993). A system for quantifying the informativeness and efficiency of the connected speech of adults with aphasia. *Journal of Speech and Hearing Research*, *36,* 338–350. doi.org/10.1044/jshr.3602.338

Nickels, L. (2002). Therapy for naming disorders: Revisiting, revising, and reviewing *Aphasiology, 16,* 935–979. doi.org/10.1080/02687030244000563

Palmer, R., Enderby, P., & Paterson, G. (2013). Using computers to enable self-management of aphasia therapy exercises for word finding: The patient and carer perspective. *International Journal of Language and Communication Disorders, 48 (5)* 508-521. doi.org/10.1111/1460-6984.12024

Paradis, M., Libben, G., & Hummel, K. (1987). *The Bilingual Aphasia Test* (English version). Hillsdale, NJ: Lawrence Erlbaum Associates.

Peach, R., & Reuter, K. (2010). A discourse-based approach to semantic feature analysis for the treatment of aphasic word retrieval failures. *Aphasiology, 24,* 971–990. doi.org/10.1080/02687030903058629

Quique, Y., Evans, W., & Dickey, E. (2019). Acquisition and generalization responses in aphasia naming treatment: A meta-analysis of semantic feature analysis outcomes. *American Journal of Speech-Language Pathology, 28*, 230-246. doi.org/10.1044/2018_AJSLP-17-0155

Rau, E., Simpson, K., & Balthazar, C. (n.d). *The Expanding Expression Tool Program: Effects on Verbal Descriptions Produced by Children with Language Impairment.* Poster Presentation. Rocky Mountain University of Health Professions, Provo Utah.

Scholl, D.S., McCabe, P., Nickels, L., & Ballard, K.K. (2021). Outcomes of semantic feature analysis treatment for aphasia with and without apraxia of speech. *International Journal of Language & Communication Disorders, 56 (3),* 485-500. doi.org/10.1111/1460-6984.12597

Smith, S. (2008). *Expanding Expression.* Bay City Michigan.

Sze, W.P., Hameau, S., Warren, J., & Best, W. (2020). Identifying the components of a successful spoken naming therapy: A meta-analysis of word-finding interventions for adults with aphasia. *Aphasiology, 35 (1),* 33-72. doi.org/10.1080/02687038.2020.1781419

van Hees, S., Angwin, A., McMahon, K., & Copland, D. (2013). A comparison of semantic feature analysis and phonological components analysis for the treatment of naming impairments in aphasia. *Neuropsychological Rehabilitation*, *23(1),* 102–132. doi.org/10.1080/09602011.2012.726201

Wambaugh, J. L., & Ferguson, M. (2007). Application of semantic feature analysis to retrieval of action names in aphasia. *Journal of Rehabilitation Research and Development*, *44*(*3*), 381-394. doi: 10.1682/jrrd.2006.05.0038

Wambaugh, J. L., Mauszycki, S., & Wright, S. (2014). Semantic feature analysis: Application to confrontation naming of actions in aphasia. *Aphasiology, 28(1),* 1–24. http://doi.org/10.1080/02687038.2013.845739

Waugh, E. (May 20, 2009). EET Writing program helps improve MEAP Scores at White Pine Academy. *Press Release.* Leslie, MI.

Wisenburn, B., & Mahoney, K. (2009). A meta-analysis of word-finding treatments for aphasia. *Aphasiology, 23,* 1338–1352. doi.org/10.1080/02687030902732745

Appendix A: Consent Form

CONSENT FORM
Semantic feature analysis and self-cueing strategies in aphasia

INTRODUCTION

As a person with aphasia, you are being invited to participate in a research study looking at whether word-finding can be aided by the explicit teaching of the use of a color-coded strand of beads, and to establish whether words will be more readily recalled within certain categories. This research study will be conducted at the University of Kansas Medical Center with Susan Jackson as the primary investigator, Kelly Zarifa as the co-investigator, and up to two graduate students in speech-language pathology enrolled at the University of Kansas Medical Center. A total of 3 subjects with aphasia will be enrolled in this research study. *You do not have to participate in this research study. Before you make a decision to participate, you should read the rest of this form*. *The main purpose of research is to benefit future patients and society in general. You might get personal benefit from participating in this study, but you should understand that the purpose of research is to create new knowledge.*

BACKGROUND

Trouble finding words is one of the characteristics that people with aphasia have in common. One of the well-known treatments for word-finding difficulty is called semantic feature analysis. In semantic feature analysis treatment, focus is placed on the meaning and features of words. Traditionally in this treatment, a worksheet is used and a person with aphasia answers different questions that help to describe a target word that is placed in the center of the worksheet. While this is a treatment, pulling out a worksheet to describe words in 'real-life' instances of word-finding problems may not be very practical.

PURPOSE

For this study, we are most interested in finding out whether the semantic feature analysis treatment is more effective if people with aphasia are taught to cue themselves to use the semantic feature analysis treatment. The purpose of this study is to find out if people with aphasia will make greater use of semantic feature analysis at times of word retrieval failure if the semantic cueing strategy is supplemented by a small, symbol-coded strand of beads with each bead associated with a different semantic feature. Another purpose is to determine whether patient use of the online cueing strategy leads to better recall of words that are within the same category of words. The long-term goal is to determine the usefulness of using a self-cueing strategy for the generalization of word-finding success to natural contexts.

PROCEDURES

You will participate in one to two assessment sessions lasting about 2 hours total. Assessments will take place either in person, or remotely through a video session. The assessment session(s) will take place before the treatment sessions begin. Personal information will be collected (e.g., gender, address, date of birth, date of stroke, handedness, medications). We will screen your vision and hearing. You will be given some aphasia tests that will include naming objects, naming pictures, repeating words and sentences, answering questions, and following some directions.

You will also participate in a series of treatment sessions lasting about 60 minutes per session, 3 times per week. The number of weeks of treatment will vary by participant but is estimated to last for 8-12 weeks. Treatments will take place either in person, or remotely through video sessions. During each treatment session, you will be asked to name words using a color-coded strand of beads to describe features of the word. Words will be cycled through twice in each session, so there will be some repetition within the same session. Brief follow-up sessions will be done twice and are expected to take about 30 minutes (once 2 weeks after completion of the study, and once 6 weeks after completion of the study).

RISKS

There are no known risks associated with this study. You may get tired or frustrated, but you may take a break at any time or stop the session and continue again on another day.

NEW FINDINGS STATEMENT

You will be informed if any significant new findings develop during the course of the study that may affect your willingness to participate in this study.

BENEFITS

You will be participating in interventions that will potentially improve your word-finding ability, and provide you with compensatory strategies to aid with your aphasia. It is hoped that additional information gained in this research study may be useful in the treatment of other persons with aphasia. We also will be able to give you information about your overall strengths and weaknesses in communication.

ALTERNATIVES

Participation in this study is voluntary. Deciding not to participate will have no effect on the care or services you receive at the University of Kansas Medical Center.

COSTS

There are no costs to you related to participation.

PAYMENT TO SUBJECTS

You will receive $100 for being in the study when you complete the study. The money is to help with the cost of transportation and other expenses due to participation.

You will be given a ClinCard, which works like a debit card. Once you complete the study, payment will be added onto your card by computer. The money will be available within 1 business day. You can use the ClinCard at an ATM or at a store. No one at KUMC will know where you spent the money.

You will be given one card during the study. If your card is lost or stolen, please call (866) 952-3795.

The KUMC Research Institute will be given your name, address, social security number, and the title of this study to allow them to set you up in the ClinCard system. Study payments are taxable income. A Form 1099 will be sent to you and the Internal Revenue Service if your payments are $600 or more in a calendar year.

Your personal information will be kept on a secure computer. It will be removed from the computer after the study is over and the money on the card has been used. Your information will not be shared with other businesses. It will be kept completely confidential.

IN THE EVENT OF INJURY

No participants are expected to have any injury or illness due to this research study. You do not give up any of your rights by signing this form. If you are hurt by the study or have any other type of problem during the study, you should immediately contact Susan Jackson at 913-588-5937.

INSTITUTIONAL DISCLAIMER

If you think you have been harmed as a result of participating in research at the University of Kansas Medical Center (KUMC), you should contact the Director, Human Research Protection Program, Mail Stop #1032, University of Kansas Medical Center, 3901 Rainbow Blvd., Kansas City, KS 66160. Under certain conditions, Kansas state law or the Kansas Tort Claims Act may allow for payment to persons who are injured in research at KUMC.

CONFIDENTIALITY AND PRIVACY AUTHORIZATION

Study records that identify research participants will be kept confidential as required by law. Researchers cannot guarantee absolute confidentiality. Efforts will be made to keep your personal information confidential. If the results of this study are published or presented in public, information that identifies participants will be removed. The privacy of health information is protected by a federal law known as the Health Insurance Portability and Accountability Act (HIPAA). By signing this consent form, you are giving permission ("authorization") for KUMC to use and share health information about you for purposes of this research study. If you decide not to sign the form, you cannot be in the study. To do this research, the research team needs to collect health information that identifies participants. The information may include items such as name, address, phone number, date of birth, or other identifiers. The research team will collect information from study activities described in the Procedures section of this form. The health information will be used at KUMC by Dr. Susan Jackson, Kelly Zarifa the graduate students involved in the study, the KUMC Research Institute, and officials at KUMC who oversee research, including members of the KUMC Human Subjects Committee and other committees and offices that review and monitor research studies. Study records might be reviewed by government officials who oversee research, if a regulatory review takes place. All study information that is sent outside KU Medical Center will have your name and other identifying characteristics removed, so that your identity will not be known. Because identifiers will be removed, your health information will not be re-disclosed by outside persons or groups and will not lose its federal privacy protection. Your permission to use and share your health information will not expire unless you cancel it. Any research information that is placed in the medical record will be kept indefinitely.

QUESTIONS

Before you sign this form, Kelly Zarifa, Susan Jackson and/or the graduate students in speech-language pathology assigned to the study should answer your question(s) to your satisfaction. If you have any more questions, concerns, or complaints after signing this form, you may contact Kelly Zarifa or Susan Jackson at (913) 588-5937. If you have any questions about the rights of research subjects, you may call (913) 588-1240 or write the Human Subjects Committee, Mail Stop #1032, University of Kansas Medical Center, 3901 Rainbow Blvd., Kansas City, KS 66160.

SUBJECT RIGHTS AND WITHDRAWAL FROM THE STUDY

You may stop being in the study at any time. Your decision to stop will not prevent you from getting treatment or services at the University of Kansas Medical Center. The entire study may be discontinued for any reason without your consent by the investigator conducting the study. Participation can be discontinued by the investigator if it is felt to be in the participant's best interest or if the participant does not follow the study requirements. You have a right to change your mind about allowing the research team to have access to your health information. If you want to cancel permission to use your health information, you should send a written request to Kelly Zarifa or Dr. Susan Jackson. The mailing address is Dr. Susan Jackson/Kelly Zarifa, University of Kansas Medical Center, Department of Hearing and Speech, Mailstop 3039, 3901 Rainbow Boulevard, Kansas City, KS 66160. If you cancel permission to use your health information, you will be withdrawn from the study. The research team will stop collecting any additional information about you. The research team may use and share information that was gathered before they received your cancellation.

CONSENT

Kelly Zarifa, Susan Jackson and/or the graduate students in speech-language pathology assigned to the study have given you information about this research study. They have explained what will be done and how long it will take. They explained any inconvenience, discomfort, or risks that may be experienced during this study. I freely and voluntarily consent to participate in this research study. I have read and understand the information in this form and have had an opportunity to ask questions and have them answered. **I will be given a signed copy of the consent form to keep for my records.**

____

Type/Print Subject's Name

____________________________________ _______ __________________

Signature of Subject Time Date

____

Type/Print Name of Person Obtaining Consent

____________________________________ __________________

Signature of Person Obtaining Consent Date

Appendix B: Surrogate Consent Form

CONSENT FORM
Semantic feature analysis and self-cueing strategies in aphasia

INTRODUCTION

As a relative or other individual who is making decisions on behalf of a person with aphasia, you are being asked to approve his or her participation in a research study looking at whether word-finding can be aided by the explicit teaching of the use of a color-coded strand of beads, and to establish whether words will be more readily recalled within certain categories. This research study will be conducted at the University of Kansas Medical Center with Susan Jackson as the primary investigator, Kelly Zarifa as the co-investigator, and up to two graduate students in speech-language pathology enrolled at the University of Kansas Medical Center. A total of 3 subjects with aphasia will be enrolled in this research study. *The potential participant (the person for whom you are making decisions) does not have to participate in this research study. The main purpose of research is to benefit future patients and society in general. Participants might get personal benefit from participating in this study, but you should understand that the purpose of research is to create new knowledge.*

BACKGROUND

Trouble finding words is one of the characteristics that people with aphasia have in common. One of the well-known treatments for word-finding difficulty is called semantic feature analysis. In semantic feature analysis treatment, focus is placed on the meaning and features of words. Traditionally in this treatment, a worksheet is used and a person with aphasia answers different questions that help to describe a target word that is placed in the center of the worksheet. While this is a treatment, pulling out a worksheet to describe words in 'real-life' instances of word-finding problems may not be very practical.

PURPOSE

For this study, we are most interested in finding out whether the semantic feature analysis treatment is more effective if people with aphasia are taught to cue themselves to use the semantic feature analysis treatment. The purpose of this study is to find out if people with aphasia will make greater use of semantic feature analysis at times of word retrieval failure if the semantic cueing strategy is supplemented by a small, symbol-coded strand of beads with each bead associated with a different semantic feature. Another purpose is to determine whether patient use of the online cueing strategy leads to better recall of words that are within the same category of words. The long-term goal is to determine the usefulness of using a self-cueing strategy for the generalization of word-finding to natural contexts.

PROCEDURES

The person with aphasia will participate in one to two assessment sessions lasting about 2 hours total. Assessments will take place either in person, or remotely through a video session. The assessment session(s) will take place before the treatment sessions begin. Personal information will be collected (e.g., gender, address, date of birth, date of stroke, handedness, medications). We will also screen the participants' vision and hearing. He/she will be given some aphasia tests that will include naming objects, naming pictures, repeating words and sentences, answering questions, and following some directions.

The person with aphasia will also participate in a series of treatment sessions lasting about 60 minutes per session, 3 times per week. The number of weeks of treatment will vary by participant, but is estimated to last for 8-12 weeks. Treatments will take place either in person, or remotely through video sessions. During each treatment session, he/she will be asked to name words using a color-coded strand of beads to describe features of the word. Words will be cycled through twice in each session, so there will be some repetition within the same session. Brief follow-up sessions will be done twice and are expected to take about 30 minutes (once 2 weeks after completion of the study, and once 6 weeks after completion of the study).

RISKS

There are no known risks associated with this study. The participant may get tired or frustrated, but may take a break at any time or stop the session and continue again on another day.

NEW FINDINGS STATEMENT

You will be informed if any significant new findings develop during the course of the study that may affect the participants' willingness to participate in this study.

BENEFITS

The person with aphasia will be participating in interventions that will potentially improve word-finding difficulty, and provide him/her with compensatory strategies to aid with aphasia. It is hoped that additional information gained in this research study may be useful in the treatment of other persons with aphasia. We also will be able to provide information about overall strengths and weaknesses in communication.

ALTERNATIVES

Participation in this study is voluntary. Deciding not to participate will have no effect on the care or services that the potential participant will receive at the University of Kansas Medical Center.

COSTS

There are no costs to you or the potential participant related to participation.

PAYMENT TO SUBJECTS

The participant will receive $100 for being in the study when the participant completes the study. The money is to help with the cost of transportation and other expenses due to participation.

The participant will be given a ClinCard, which works like a debit card. Once the participant completes the study, payment will be added onto the participant's card by computer. The money will be available within 1 business day. The participant can use the ClinCard at an ATM or at a store. No one at KUMC will know where you spent the money.

The participant will be given one card during the study. If the participant's card is lost or stolen, please call (866) 952-3795.

The KUMC Research Institute will be given the participant's name, address, social security number, and the title of this study to allow them to set up the participant in the ClinCard system. Study payments are taxable income. A Form 1099 will be sent to the participant and the Internal Revenue Service if the participant's payments are $600 or more in a calendar year.

The participant's personal information will be kept on a secure computer. It will be removed from the computer after the study is over and the money on the card has been used. The participant's information will not be shared with other businesses. It will be kept completely confidential.

IN THE EVENT OF INJURY

No participants are expected to have any injury or illness due to this research study. The study participant does not give up any rights by your signing this form. If the participant is hurt by the study or have any other type of problem during the study, you should immediately contact Susan Jackson at 913-588-5937.

INSTITUTIONAL DISCLAIMER

If you think the participant has been harmed as a result of participating in research at the University of Kansas Medical Center (KUMC), you should contact the Director, Human Research Protection Program, Mail Stop #1032, University of Kansas Medical Center, 3901 Rainbow Blvd., Kansas City, KS 66160. Under certain conditions, Kansas state law or the Kansas Tort Claims Act may allow for payment to persons who are injured in research at KUMC.

CONFIDENTIALITY AND PRIVACY AUTHORIZATION

Study records that identify research participants will be kept confidential as required by law. Researchers cannot guarantee absolute confidentiality. Efforts will be made to keep personal information confidential. If the results of this study are published or presented in public, information that identifies participants will be removed.

The privacy of health information is protected by a federal law known as the Health Insurance Portability and Accountability Act (HIPAA). By signing this consent form, you are giving permission ("authorization") for KUMC to use and share health information about the participant for purposes of this research study. If you decide not to sign the form, the potential participant cannot be in the study.

To do this research, the research team needs to collect health information that identifies participants. The information may include items such as name, address, phone number, date of birth, or other identifiers. The research team will collect information from study activities described in the Procedures section of this form. The health information will be used at KUMC by Dr. Susan Jackson, Kelly Zarifa, the graduate students involved in the study, the KUMC Research Institute, and officials at KUMC who oversee research, including members of the KUMC Human Subjects Committee and other committees and offices that review and monitor research studies. Study records might be reviewed by government officials who oversee research, if a regulatory review takes place.

All study information that is sent outside KU Medical Center will have the participants' name and other identifying characteristics removed, so that the participants' identity will not be known. Because identifiers will be removed, health information will not be re-disclosed by outside persons or groups and will not lose its federal privacy protection. Permission to use and share the participants' health information will not expire unless you cancel it. Any research information that is placed in the medical record will be kept indefinitely.

QUESTIONS

Before you sign this form, Kelly Zarifa, or Susan Jackson, and/or the graduate students in speech-language pathology assigned to the study should answer your question(s) to your satisfaction. If you have any more questions, concerns, or complaints after signing this form, you may contact Kelly Zarifa or Susan Jackson at (913) 588-5937. If you have any questions about the rights of research subjects, you may call (913) 588-1240 or write the Human Subjects Committee, Mail Stop #1032, University of Kansas Medical Center, 3901 Rainbow Blvd., Kansas City, KS 66160.

SUBJECT RIGHTS AND WITHDRAWAL FROM THE STUDY

Participation in this study is voluntary. The choice not to participate or to quit will have no effect upon the medical care or treatment that is received now or in the future at the University of Kansas Medical Center. The entire study may be discontinued for any reason without your consent by the investigator conducting the study. Participation can be discontinued by the investigator if it is felt to be in the participant's best interest or if the participant does not follow the study requirements.

You have a right to change your mind about allowing the research team to have access to the participants' health information. If you or the participant wants to cancel permission of the use of their health information, you or the participant should send a written request to Kelly Zarifa or Dr. Susan Jackson. The mailing address is Dr. Susan Jackson/Kelly Zarifa, University of Kansas Medical Center, Department of Hearing and Speech, Mailstop 3039, 3901 Rainbow Boulevard, Kansas City, KS 66160.

If permission to use the participant's health information is cancelled, he or she will be withdrawn from the study. The research team will stop collecting any additional information. The research team may use and share information that was gathered before they received your cancellation.

CONSENT

Kelly Zarifa and/or Susan Jackson, and/or the graduate students in speech-language pathology assigned to the study have given you information about this research study. They have explained what will be done and how long it will take. They explained any inconvenience, discomfort, or risks that may be experienced during this study.

If the participant becomes able to consent to research during the course of the study, the information in the form will be presented to him/her for his/her consent.

On behalf pf the person for whom you are making decisions, you freely and voluntarily consent for that persons to participate in this research study. You have read and understand the information in this form and have had an opportunity to ask questions and have them answered. **You will be given a signed copy of the consent form to keep for your records.**

As a legal guardian or representative, I, ___________________________________, Type/Print name of guardian/representative

authorize the participation of ___________________________ in this research study.
type/print name of participant

I understand that I may not authorize participation in this study if the individual has expressed wishes to the contrary, either orally or in writing.

I am (please initial one of the following categories):

_______ Legal guardian or Durable Power of Attorney for Healthcare Decisions
_______ Adult or emancipated minor's spouse (unless legally separated)
_______ Adult child
_______ Parent
_______ Adult relative by blood or marriage

_____________________________________ ___________________

Signature of Legal Guardian/ Representative *Date*

____

Type/Print Name of Person Obtaining Consent

_____________________________________ ___________________

Signature of Person Obtaining Consent *Date*

Appendix C: Assent Form

Semantic feature analysis and self-cueing strategies in aphasia

ASSENT FORM

I have aphasia. I am being asked to be in a research project.

I will be asked to name objects, describe objects, answer some questions, follow some directions, and do some other tasks with words.

I might do this research in person, or I might do this research on a computer or other screen.

If I sign my name to the line, it means that I want to be part of the research. I know that I do not have to do it and that I can stop being in the research at any time even if I signed. If I want to stop, all I have to do is tell a family member, one of the people who take care of me, or the researcher from the University of Kansas.

_________________________ Signature of Subject

KUMC IRB # STUDY00142915 | Approval Period 5/27/2020 – 5/4/2021 | FWA# 00003411

Appendix D: Hearing Screening - Semantic Feature Analysis and Self-Cueing Strategies in Aphasia

Participant pseudonym: ________________

Initial Screening Date: ________________

Items presented verbally

Aided Hearing (e.g., hearing aids, CI, etc.)	Yes	No	
1. Clap your hands	0	1	R x__
2. Touch your head	0	1	R x__
3. Stick out your tongue	0	1	R x__
4. Point to your nose	0	1	R x__
5. Look at the ceiling	0	1	R x__

Score:_____/5

**R indicates repetitions*

Appendix E: Vision Screening - Semantic Feature Analysis and Self-Cueing Strategies in Aphasia

Participant pseudonym: ________________

Initial Screening Date: ________________

Participants are shown a target picture and asked to match it to an identical picture from a field of four (one matching target and three foils).

Aided Vision (e.g., glasses, bifocals, contacts, etc.) Yes No

Stimulus Set (example) elephant

- House
- Ball
- Elephant (target)
- Fork

Target 1: _______cake______________	0	1
Target 2: _______umbrella___________	0	1
Target 3: ________dog______________	0	1
Target 4: ________saw______________	0	1
Target 5: ________carrots____________	0	1

Score:_____/5

Appendix E continued: Vision Screening - Semantic Feature Analysis and Self-Cueing Strategies in Aphasia

1. Stimulus Set #1	0	1
• Gas		
• Cake (target)		
• Towel		
• Chair		
2. Stimulus Set #2	0	1
• Umbrella (target)		
• Wrench		
• Refrigerator		
• Cat		
3. Stimulus Set #3	0	1
• Flowers		
• Dog (target)		
• Book		
• Candy		
4. Stimulus Set #4	0	1
• Car		
• Broom		
• Chicken		
• Saw (target)		
5. Stimulus Set #5	0	1
• Shoes		
• Butterfly		
• Carrots (target)		
• Whistle		

Score:_____/5

Appendix F: Demographic Information Form-Semantic Feature Analysis and Self-Cueing Strategies in Aphasia

Participant pseudonym: ________________
Initial Screening Date: ________________

DOB: ____/____/____
Gender: Male Female
Handedness: Right Left
Consent Type: Consent Surrogate Assent
Race/Ethnicity: White/ Caucasian Black/ African-American Native-American

Hispanic/ Latin-American Asian/ Pacific Islander Other

Hx of other neurologic disease: Yes No (e.g., TBI, PD, AD, hx of alcohol abuse):

Multiple Strokes: Yes No

Date of stroke: ____/____/____ Time post onset: ______yrs _____mos

Location of stroke: Left Right

Level of Education: ____

Current Speech, Language, Cognitive Services: Yes (describe below) No

____

____

Current Medications: ____

____

Passed Hearing Screen: Yes No Score:_____/5

Passed Vision Screen: Yes No Score:_____/5

Naming Probe Score: ____/10 ____/10 ____/10 ____/10

Other:

____

____

____

Appendix G: Visual Complexity and Familiarity Ratings by Participant and Category

Participant 1

Category 1	Familiarity	Visual Complexity	Familiarity	Visual Complexity	
Treated Activity & Sport					**Untreated Activity & Sport**
basketball hoop	4.6	2.33	4.1	2.98	exercise bike
parachute	3.95	2.71	3.57	2.71	snowshoe
lifesaver	4.36	1.79	4.4	1.71	beach umbrella
stroller	4.43	2.79	4.57	2.74	rollerblade
trampoline	4.4	1.98	3.38	1.71	gymnastic rings
	4.35	**2.32**	**4.04**	**2.37**	

Participant 1

Category 2	Familiarity	Visual Complexity	Familiarity	Visual Complexity	
Treated Kitchen					**Untreated Kitchen**
salad spinner	3.79	2.45	3.74	2.48	panini grill
serving spoon	4.67	1.59	4.71	1.67	travel mug
blender	4.43	2.17	4.69	2.19	microwave
cake platter	3.71	2.29	4.43	2.24	toaster oven
muffin tray	4.69	1.9	4.76	1.74	salt shaker
	4.26	**2.08**	**4.47**	**2.06**	

Participant 1

Category 3	Familiarity	Visual Complexity	Familiarity	Visual Complexity	
Treated Musical Instruments					**Untreated Musical Instruments**
music sheet	4.36	2.74	4.43	2.83	keyboard
tuba	3.86	3.14	4.52	2.14	guitar case
acoustic guitar	4.52	2.45	4.5	2.64	electric guitar
recorder	4.5	2.05	4.31	2	music stand
chime	3.8	2.24	3.8	2.44	rain stick
	4.2	**2.5**	**4.3**	**2.41**	

Participant 1

Category 4	Familiarity	Visual Complexity
Untreated Decoration & Gifts		
noisemaker	4.22	2.1
birthday candle	4.69	1.83
jack-o-lantern	4.71	2.43
antlers	4.02	2.45
disco ball	4.55	2.6
lantern	4.02	2.45
coat hook	4.4	1.69
snow globe	4.12	2.9
garden gnome	4	2.48
nut-cracker	3.83	2.88
	4.26	**2.38**

Appendix G continued: Visual Complexity and Familiarity Ratings by Participant and Category

Participant 2

Category 1	Familiarity	Visual Complexity	Familiarity	Visual Complexity	
Treated Building Infrastructure					**Untreated Building Infrastructure**
barn	4	2.55	3.76	2.79	gazebo
traffic light	4.74	2.1	4.52	2.29	parking meter
dumpster	4.41	2.12	4.43	2.02	port-a-potty
lighthouse	4.1	2.71	4	2.69	sprinkler
awning	4.15	1.9	4.43	1.98	tombstone
	4.28	**2.78**	**4.23**	**2.35**	

Participant 2

Category 2	Familiarity	Visual Complexity	Familiarity	Visual Complexity	
Treated Vehicles					**Untreated Vehicles**
helicopter	4.24	3.25	4.12	3.37	bulldozer
wheelchair	4.52	2.79	4.33	2.9	bumper car
shopping cart	4.71	2.38	4.76	2.69	school bus
cement truck	4.45	3.26	4.55	2.57	lawn mower
sailboat	4.07	3.24	4.05	3.1	steam roller
	4.4	**2.98**	**4.36**	**2.92**	

Participant 2

Category 3	Familiarity	Visual Complexity	Familiarity	Visual Complexity	
Treated Food					**Untreated Food**
artichoke	3.98	2.76	4.1	2.63	honeycomb
bread	4.34	2.39	4.4	2.45	sunflower seeds
kiwi	4.71	2.38	4.74	2.62	granola bar
macaroni	4.79	1.93	4.74	1.86	jellybean
candy cane	4.9	1.69	4.76	1.57	lollipop
	4.54	**2.23**	**4.55**	**2.26**	

Participant 2

Category 4	Familiarity	Visual Complexity
Untreated Animals		
platypus	3.69	3.05
kangaroo	4.21	2.9
badger	3.22	3.37
chipmunk	4.37	3.02
raccoon	3.81	3.21
warthog	3.45	3.17
moose	4.29	3.07
bison	3.95	3.17
antelope	3.67	2.95
hippopotamus	4.24	2.93
	3.89	**3.08**

Appendix G continued: Visual Complexity and Familiarity Ratings by Participant and Category

Participant 3

Category 1	Familiarity	Visual Complexity	Familiarity	Visual Complexity	
Treated Vehicles					**Untreated Vehicles**
windshield wiper	2.1	4.32	4.12	3.37	bulldozer
wheelchair	4.52	2.79	4.33	2.9	bumper car
shopping cart	4.71	2.38	4.76	2.69	school bus
cement truck	4.45	3.26	4.55	2.57	lawn mower
sailboat	4.07	3.24	4.05	3.1	steam roller
	3.97	**3.2**	**4.36**	**2.92**	

Participant 3

Category 2	Familiarity	Visual Complexity	Familiarity	Visual Complexity	
Treated Food					**Untreated Food**
artichoke	3.98	2.76	4.1	2.63	honeycomb
bread	4.34	2.39	4.4	2.45	sunflower seeds
kiwi	4.71	2.38	4.74	2.62	granola bar
macaroni	4.79	1.93	4.74	1.86	jellybean
candy cane	4.9	1.69	4.73	1.95	tomato
	4.54	**2.23**	**4.54**	**2.30**	

Participant 3

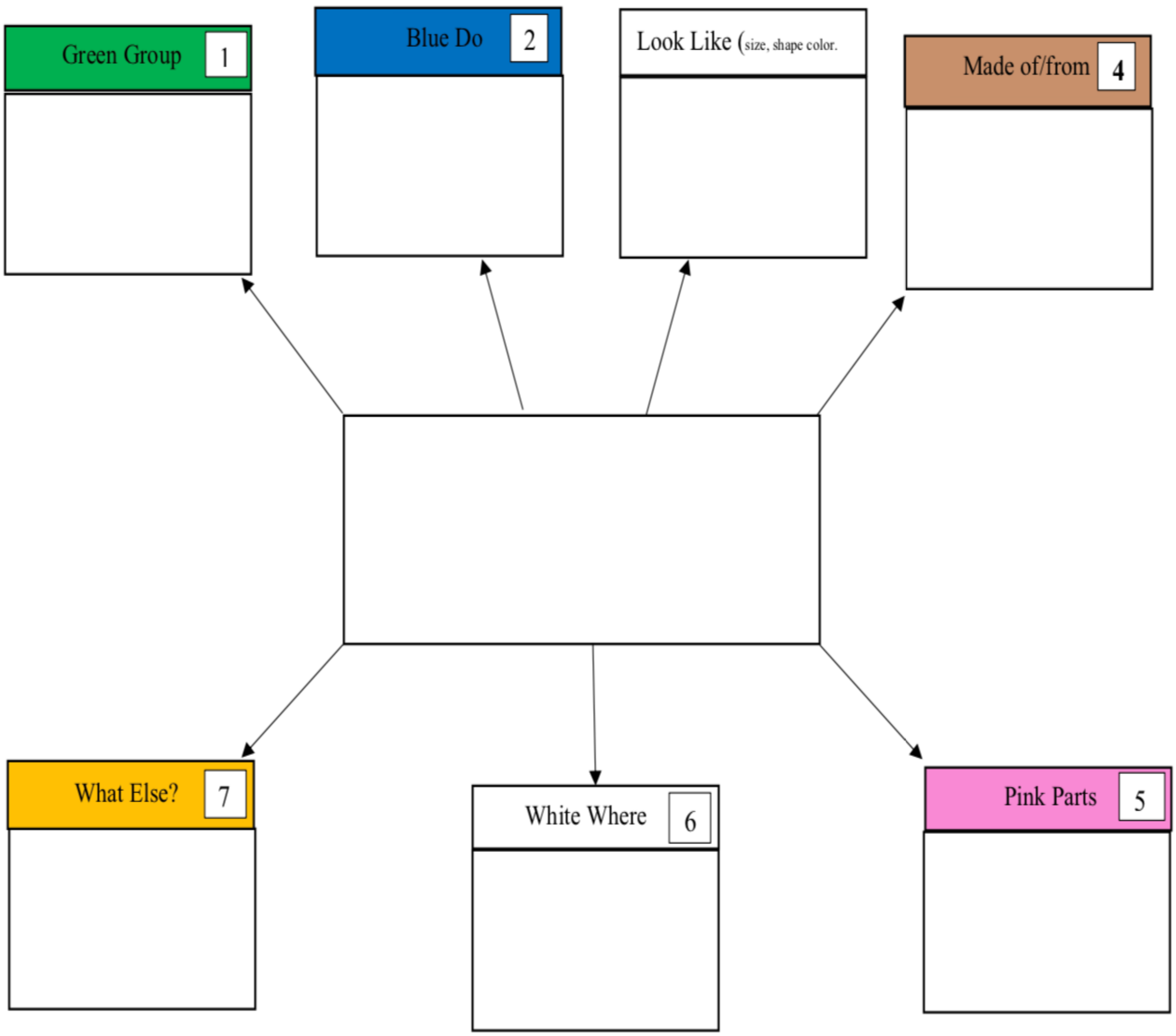
Category 3	Familiarity	Visual Complexity	Familiarity	Visual Complexity	
Treated Activity & Sport					**Untreated Activity & Sport**
basketball hoop	4.6	2.33	4.1	2.98	exercise bike
parachute	3.95	2.71	3.57	2.71	snowshoe
lifesaver	4.36	1.79	4.4	1.71	beach umbrella
stroller	4.43	2.79	4.57	2.74	rollerblade
trampoline	4.4	1.98	3.38	1.71	gymnastic rings
	4.35	**2.32**	**4.04**	**2.37**	

Participant 3

Category 4	Familiarity	Visual Complexity
Untreated Animals		
warthog	3.45	3.17
moose	4.29	3.07
bison	3.95	3.17
platypus	3.69	3.05
kangaroo	4.21	2.9
badger	3.22	3.37
chipmunk	4.37	3.02
antelope	3.67	2.95
hippopotamus	4.24	2.93
raccoon	3.81	3.21
	3.89	**3.08**

Appendix H: EET strand and poster visual

Appendix I: Modified SFA Chart with EET Characteristics



Appendix J: COVID-19 modification list/study impacts

- Study changed from in-person to remote study via secure platform
  - Participant/family member challenges with technology set-up
  - Environmental distractions during intervention sessions
  - Changes in subject recruitment due to study format
  - Remote administration of standardized assessments that are not validated for remote administration

- Reduced interaction with participants and instruction in use of EET
  - Possible implications for outcomes of study

- Change from two graduate student assistants plus PI to PI only

- Unable to video record treatment secondary to incompatibility of available technology
  - unable to conduct fidelity checks or take reliability data
  - unable to review video and collect data regarding use of EET strand (participant picking up strand, touching beads, etc.) as video camera angles did not allow for optimal viewing.

Appendix K: Cueing Data Collection Sheet

Participant Pseudonym ______________

KEY
+ = independent
- = Prompted (verbal & visual supplied together)
* = Researcher supplied

Date _____________________ Session #______

Semantic Feature						**Session Total**
Green Group						
Blue Do						
Look Like						
Made Of						
Parts						
White Where						
What Else						

Date _____________________ Session #______

Semantic Feature						**Session Total**
Green Group						
Blue Do						
Look Like						
Made Of						
Parts						
White Where						
What Else						