Proposal

The concept of working memory involves a short duration system in which small amounts of information are simultaneously stored and manipulated in the service of accomplishing a task (Caplan & Waters, 1999). Individuals with aphasia have working memory impairments to the extent they suffer from executive functioning limitations and deficits specific to language areas including syntax, phonology, and semantics (Laures, Odell, & Coe,2003; Wright & Shisler, 2005). In particular, deficits in working memory could contribute to a breakdown in word retrieval which can restrict the participation of an individual with aphasia in the most meaningful communication activities, particularly conversation (Goodglass & Wingfield, 1997). There is evidence that a Semantic Feature Analysis (SFA) improved word retrieval and even conversation in individuals with aphasia by providing semantic cueing for access to the semantic and phonological networks (Massaro & Tompkins, 1992; Rider, Wright, Marshall, & Page, 2008; Peach & Reuter, 2009).

This study implemented a modified SFA to enhance the ability to use semantically related categories as catalysts for retrieving targets topics over time. Features of the SFA included superordinate category, use, location, physical properties, association, and coordinate categories (Rider et al., 2008). SFA is an approach in which each participant was guided to produce words or phrases that are semantically associated to the target topic (Rider et al., 2008). The present study investigated whether a modified SFA trained within conversation improved working memory for the topic, word retrieval skills, and conversational management in two participants with fluent aphasia.

The modified SFA treatment consisted of using preselected topics (e.g. computers) during conversation. Then, the clinician asked each participant to produce semantically related features regarding the target topic. The participant was then asked to answer questions such as the purpose of the topic of conversation, general or physical characteristics about the topic, (e.g. located in North America) and personal associations of these topics to each participant.

Methods:
The participants in this study were two males with anomic aphasia. Participant 1 (P1)was a 73-year- old male, with a graduate level education, who suffered a left cerebrovascular accident (CVA) in the anterior parietal lobe three years prior to the study. Both participants were evaluated using the Western Aphasia Battery (WAB) and the Boston Naming Test (BNT). P1's score on the WAB earned him an aphasia quotient of 96.4 indicating anomic aphasia. On the BNT, P1 earned a score of 45. The second participant (P2) was a 57-year-old male, with a high school level education, who had a frontoparietal lobe CVA three years prior to this study. On the WAB, his aphasia quotient was 94.6 indicating an anomic aphasia and a BNT score of 48. Additionally, both participants were evaluated before treatment for working memory impairments using a cognitive battery of tests adapted from (Frankel, 2008) including the Self Order Pointing Test, (Spreen & Strauss, 1998), the Medical College of Georgia Complex Figures (Spreen & Strauss, 1998), the Wisconsin Card Sorting Test (Ormond Software Enterprises, 1999), and the Digit Spans Test (Lezak, Howelson, Loring, Hannay, & Fisher, 2004). The results of this cognitive battery are located in Table 1 indicating that both participants demonstrated impairments in working memory processing including poor recall, difficulty following directions, difficulty shifting attention, and decreased word recognition.

Procedures:

Design: A multiple-baseline-across-behaviors design (Rider et al., 2008) was used to train pre-selected topics using SFA. The design was modified to include, pre-treatment, treatment, and post-treatment probes and a one-month follow-up to assess maintenance.

Pre-Treatment and Post-Treatment Phases: During pre-and post-treatment phases, both participants were judged on 3 pre-treatment and 3 post-treatment conversations with a familiar interlocutor. Pre-treatment, post-treatment, and follow-up sessions obtained conversations that were analyzed using conversational analysis protocol. All phases of conversations were audiotaped for 30 minutes. A quantitative conversational analysis was used to analyze P1 and P2's use of nouns, verbs, independent causes, modifier clauses, embedded clauses, subordinate clauses, speech rate (word/min), phrase length (words/per syntactic unit), phonemic errors, grammatical errors, and semantic errors (Knibb et al., 2009). Qualitatively, within each conversation sample, the participants were judged by four raters using conversational analysis methods to determine the use of working memory for the conversational topic in relation to topic management, initiation, turn-taking, and conversational repair (Perkins et al., 1999).

Treatment Phase: Each participant attended 3 treatment sessions per week for 4 weeks. This length of treatment (12 treatment sessions) was chosen based on the observation that the participants in the previous studies who benefitted from treatment achieved the level of improvement within this time frame (Boyle & Coelho, 1995; Coehlo, McHugh, & Boyle, 2000).Each week, preselected topics were chosen for each treatment session. Next, the clinician encouraged both participants to produce words or phrases that were semantically related to the target topic. An SFA diagram was used during treatment to help the participants recall the semantic features for each topic. Only those semantic features deemed appropriate for each target topic were elicited. Then, the clinician guided the participants, through prompts and questions, to include features that were important to the topic of conversation.

Maintenance and Generalization Phase: Both participants completed a follow-up session one month after post-treatment to assess the generalization to untreated topics of conversation. Similarly, conversational analysis methods were implemented to observe changes in conversational fluency and working memory.

Conclusions:

The data for the pre-treatment, post-treatment, and follow-up phases are in Figures 1, 2, and 3. P1 and P2 both demonstrated an increased number of nouns (follow-up $M=26\%$,$sd=2.2$, p $<.05$),verbs (follow-up $M=26.5\%$, $sd=1.3$, p$<.05$), independent clauses(M=35%, $sd=1.8$, p$<.05$),and words per minute (follow-up $M=22\%$, $sd=1.8$, p$<.05$) during the follow-up session. Additionally, both participants increased in the average phrase lengths (follow-up $M=11.8\%$; $sd=1.8$, p$<.05$). Each participant demonstrated fewer phonemic errors (follow-up $M=23.5\%$, $sd=1.26$, p $<.05$) and semantic errors (follow-up $M=8\%$, $sd=1.2$, p$<.05$) throughout the treatment study possibly due to the type of aphasia. Furthermore, as the participants phrase lengths increased so did the number of grammatical errors ($M=38.3\%$, $sd=2.9$, p$<.05$) produced during conversation. It is possible to theoreticize that both participants produced more grammatical errors during post-treatment and follow-up phases due to the syntactic complexity

of the target topics and the phonological memory load that was required to use the SFA features during a complex task such as conversation. Additionally, it is possible to postulate that these participants were three years post-stroke and they initially presented with agrammatic Broca's aphasia.

There was no significant difference found for the number of modifier (follow-up $M=1.3\%$, $sd=.98$, $p>.05$), embedded (follow-up $M=.33\%$, $sd=.65$, $p>.05$), and subordinate clauses (follow-up $M=.01$, $sd=.00$, $p>.05$) in this study.

 In the qualitative analysis, P1 and P2 exhibited increased topic maintenance (follow-up $M=61\%$, $sd=1.0$, $p<.05$) and initiation during the (follow-up $M=49\%$, $sd=1.2$, $p<.05$) follow-up phase. P2 only produced increased turn-taking abilities as judged by the four raters (follow-up $M=55\%$, $sd=1.3$, $p<.05$). Overall, both participants were able to repair (follow-up $M=70.6\%$, $sd=1.6$, $p< .05$) and maintain the topic of conversation.

Discussion:
This modified SFA treatment appears effective in increasing conversational fluency and working memory in fluent aphasics. During the follow-up phases, it became evident that both participants were using the modified SFA to help extend their conversation abilities during new topics.

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Table 1. Participant data

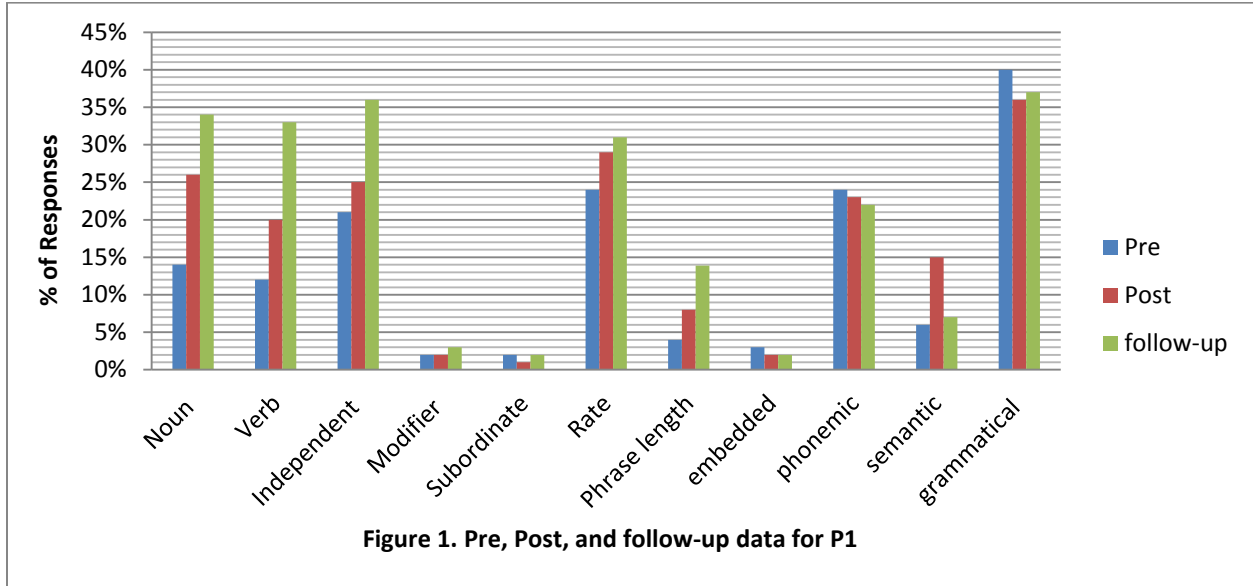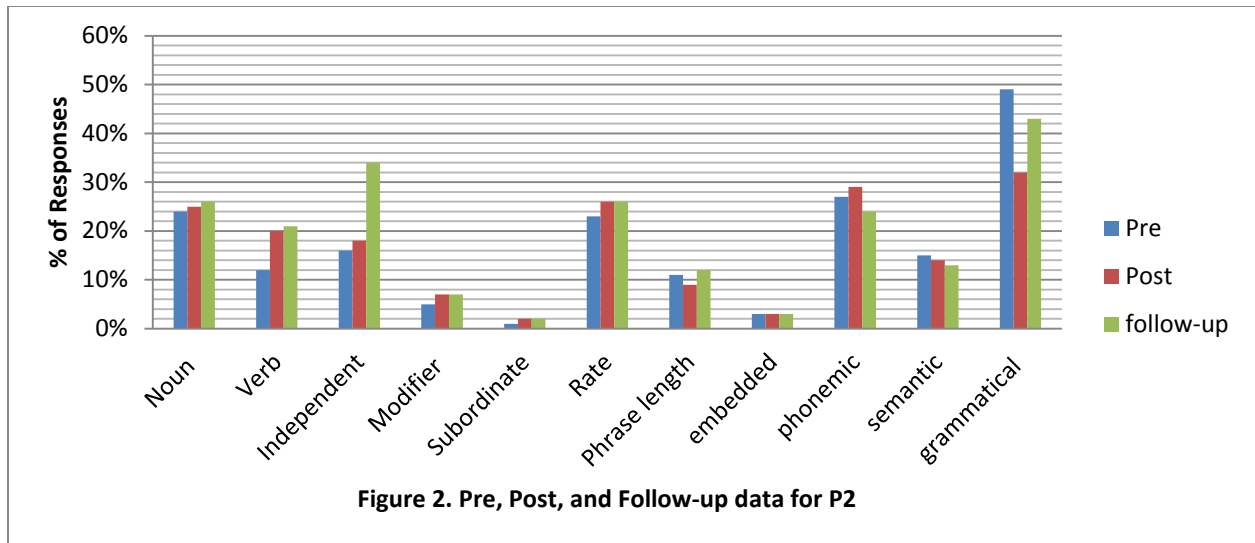|	Western Aphasia Battery	Boston Naming Test	Self Ordered Pointing Test	Digit Span Test	Wisconsin Card Sorting Test	Medical College of Georgia Complex Figures
P1	96.4	45	21	3	98 errors Standard score: 63 T- score:25 1st percentile	17.5
P2	94.6	48	20	3	92 errors Standard score: 55 T-score:20 Less than <1st percentile	10

Figure 1.

Figure 1. Pre, Post, and follow-up data for P1

Figure 2.

Figure 2. Pre, Post, and Follow-up data for P2

Figure 3.

Figure 3. P1. and P2 data for qualitative analysis of conversational topics among raters