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A Comparison of Two Treatment Approaches for Agrammatic Broca's Aphasia: Script Therapy vs. Verb Network Strengthening Treatment

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A Comparison of Two Treatment Approaches for Agrammatic Broca's

Aphasia: Script Therapy vs. Verb Network Strengthening Treatment

By

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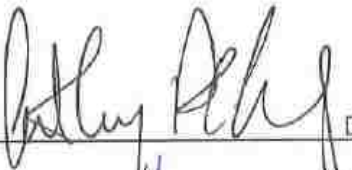modifications to the text of the doctoral dissertation for the Ph.D. during the **Fall Semester 2017.**

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TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Background/Introduction: Individuals with agrammatic Broca's aphasia frequently are treated at single word level, verb priming, or simple sentence structure treatments. In this study, an impairment specific treatment such as Verb Network Strengthening Treatment (VNeST) was explored as well as a social functional approach such as Script Therapy. These two approaches were assessed by the outcome measures of rate of speech, subject-verb-object production, and error rates during probe tasks.

Objective: To examine the impact of two treatment approaches: Script Therapy and Verb Network Strengthening Treatment for two individuals with chronic agrammatic Broca's aphasia.

Method: A single subject multiple baseline alternating treatment across participants' design was implemented. Each participant received each therapy for 9 weeks and both treatments were counterbalanced. Generalization probes were administered on the second session of each treatment per week to assess pre-to-post outcome measures including rate of speech, subject-verb-object production (SVO), and error rate. Effect sizes were calculated for baseline through maintenance outcome measures. To analyze the inter-therapeutic effects of the two treatment, the Percentage of data Exceeding the Median was used.

Results: Both participants improved over the 18 weeks on rate of speech and subject verb-object (SVO) production during probe tasks. For P1, Error rates decreased from baseline to maintenance phases. Effect sizes were calculated for the baseline to maintenance phases using the Busk & Serlin's *d2* formula (1992). The effects size calculations were compared using the Beeson & Robey (2006) benchmarks for lexical and syntactic metanalyses for aphasia. For the baseline to maintenance effects, small effect sizes were found for both participants for rate of speech. For P1, a medium to large effect was noted for SVO production. P2's effect size for SVO production revealed no effect. Error rates for P1 revealed no effect. P2's error rate produced a small unfavorable effect.

Conclusions: Both participants benefitted from the two treatment approaches in individual ways. It is possible that the multi-modal nature of the training between VNeST and Script that engaged functional sentence production and a linguistic approach for sentence production contributed to a positive language change for these participants.

Keywords: Impairment specific approach, social functional approach, agrammatic Broca's aphasia, Verb Network Strengthening Treatment, Script Therapy

Chapter I

INTRODUCTION

Aphasia is an acquired neurogenic language disorder affecting the

production or comprehension of speech and possibly ability to read or write

(Cherney, Halper, & Kaye, 2008). It can be caused by damage to the brain,

often as a result of stroke or traumatic brain injury. Commonly in aphasia, the

damage occurs mostly in the left cerebral hemisphere. In some cases,

aphasia can affect the expressive and receptive components of language as

well as reading and writing. In conjunction with the linguistic aspects of

language, aphasia can also affect the social aspects of language leading to

social isolation and reduced participation in life activities (Bilda, 2011).

Aphasia often has profound effects on communicative interactions for

both everyday activities and exceptional life experiences. The inability to

access fluent and accurate language in routine daily interactions can have

tangible practical and psychosocial consequences. For individuals with

aphasia, life responsibilities that require particularly efficient language

production such as interviewing for a job may seem beyond reach.

Speech-language therapy for individuals with aphasia has

predominately focused on single aspects of language recovery including word

retrieval and naming. Single aspects of language therapy have ranged from simple cloze phrase word retrieval tasks to canonical and non-canonical sentence production (Ballard & Thompson, 1999; Edmonds & Babb, 2011; Edmonds, Nadeau, & Kiran, 2009; Martin, Fink, & Laine, 2004). For this population, the specific treatments that target individual aspects of language at the word or sentence level are necessary; however, it is critical to address more functional communicative methods.

This study compares two well-known treatment methods for agrammatic Broca's aphasia: Verb Network Strengthening Treatment (VNeST) and Script Therapy. Both treatment options stem from a different aspect of language. VNeST focuses more on the building of the linguistic levels such as subject, verb, and object phrases. Alternatively, Script therapy focuses on the scripting of personal sentences to enhance functional communication. Previous studies with agrammatic Broca's aphasia failed to examine a linguistic approach such as VNeST when compared to a functional treatment approach such as Script therapy. A comparative study of these methods will reveal which method of treatment is more efficacious.

In daily clinical routine, clinicians are compelled to choose their methods of treatment to provide cost-effective treatment to patients with aphasia. Although the methods under scrutiny, in this study, have the same common objective of enhancing fluency in language production, these two methods originate from different theoretical backgrounds: VNeST works at a

more basic linguistic level of verb training and expects mastery at this level will generalize to connected speech/natural language production, whereas the 'Script' treatment trains language production at a higher level, namely, discourse or Script.

Thus, the outcome of the current study will have implications for these theoretical view points on how to achieve fluent language production in agrammatic aphasia. The comparison of these two treatments in this study has not been previously researched with individuals with agrammatic Broca's aphasia. The relative cost of each treatment is inexpensive and both have merits at improving language in this population. Therefore, the purpose of this study is to examine and compare both treatments to one another and to draw conclusions about the relative benefits of each treatment. In doing so, the merits of each can be combined to provide individuals with aphasia with cost effective therapeutic interventions that improve language. Additionally, it is also important to determine which therapy: VNeST or Script is more effective in promoting grammatically correct language for individuals with agrammatic Broca's aphasia.

Chapter II

LITERATURE REVIEW

Aphasia: Fluent vs. Non-Fluent

There are two primary types of aphasia: fluent and non-fluent. Fluent

aphasia can be characterized by impairments in the reception of language,

with difficulties in auditory verbal comprehension or in the repetition of words,

phrases, or sentences spoken by others. An individual with fluent aphasia's

speech is often easy and fluent, but there are difficulties related to the output

of language such as production. Non-fluent aphasia can be characterized by

difficulties in the articulation and production of language, but in most cases

there is relatively good auditory verbal comprehension (Clark, Charuvasta,

Miller, Shapiro, & Mendez, 2005). Chronic non-fluent aphasia is a lifelong

handicap that can often lead to social isolation, loss of autonomy, and

restricted social activity (Bilda, 2011).

To define the nature of non-fluent language production, investigators

have defined non-fluent speech as interrupted, awkwardly articulating with

great effort. Additionally, non-fluent speech as marked by difficulty with

articulation and long runs of words in a variety of grammatical constructions

(Gordon, 1998). To further explain non-fluent and fluent speech, researchers have used quantitative and qualitative measures such as speech rate, pausing, phrase length, error production, self-correction attempts, semantic content, syntactic content, and grammatical form (Ballard & Thompson, 1999; Kiran & Thompson, 2003; Peach & Wong, 2004.) Fluent language production can be determined by a number of linguistic factors including the ability to produce appropriate morphology, lexical retrieval, sentence production, grammatical form, and conversational exchanges (Ballard & Thompson, 1999; Edmonds & Babb, 2011; Edmonds, Nadeau, & Kiran, 2009; Martin, Fink, & Laine, 2004; Nickels, 2002; Raymer & Ellsworth, 2002)

Agrammatic Broca's aphasia

When defining the nature of agrammatic Broca's aphasia, it can be characterized by agrammatism or telegraphic speech, as well as deficits, in morphology, lexical retrieval, syntax, and discourse or conversation. Typically, individuals with Broca's aphasia present with relatively intact comprehension. A patient with agrammatic Broca's aphasia speech production is characterized by slow, halting speech, phonemic paraphasias, anomia, recurring utterances or perservations, articulatory impairments, and possibly apraxia of speech. Additionally, other aspects of language including the ability to produce sentences can be impacted with agrammatic Broca's aphasia.

Sentence Production Deficits

Agrammatism is characterized by an inability to construct a grammatical or intelligible sentence while retaining the ability to verbally produce single words (Jacobs & Thompson, 2000). Individuals with agrammatism present with an inability to speak grammatically because of brain injury or disease, usually with simplified sentence structure and errors in tense, number, and gender. Furthermore, individuals with agrammatism present with difficulty comprehending and producing semantically correct sentence. An example of agrammatic speech would be "Well…woman and…..dishes .um, well, um…forget it". Treatment options for agrammatic aphasia vary with severity levels. Some treatments address training language at the verb level. For example, Treatment of Underlying Forms (TUF) is an approach that focuses on complex, non-canonical sentence structures and operates on the premise that training underlying, abstract, properties of language will allow for sentence production (Thompson & Shapiro, 2005). Sentence production deficits in patients with agrammatic Broca's aphasia appears to be efficacious when the lexical and syntactic properties of (a) the language deficit exhibited by the aphasic individuals and (b) the sentences selected are for treatment and generalization.

Morphological Deficits

One of the hallmarks of agrammatic-type Broca's aphasia is a deficit in the production of functional morphology (Thompson & Shapiro, 2005). Individuals with agrammatic Broca's aphasia may exhibit impaired lexical processing which greatly impedes their ability to construct sentences and communicate fluently. Morphology is defined as the study of internal word structure and the way morphemes combine to form words (Lee, Mack, & Thompson, 2012). Accordingly, individuals with agrammatic Broca's aphasia exhibit difficulty in understanding or producing complex lexical items that can be characterized as having a morphological impairment. Individuals with morphological impairments typically have left frontal damage which has repeatedly been shown to have increased difficulty inflecting verbs as compared to nouns. A selective impairment of verb morphology has been linked to individuals with agrammatic Broca's aphasia presenting with non-fluent, highly reduced speech lacking grammatical features, and a decrease in the production of verbs and nouns (Ballard & Thompson, 1999; Edmonds & Babb, 2011; Edmonds, Nadeau, & Kiran, 2009; Martin, Fink, & Laine, 2004; Nickels, 2002; Raymer, & Ellsworth, 2002;Cameron, Wambaugh & Mauszycki, 2010;Wambaugh & Ferguson, 2007; Peach & Reuter, 2010; Wilkinson, Bryan, Lock, & Sage, 2010; Lee, Kaye,& Cherney, 2009; Basso, 2010). An example of morphological deficits from this study would be the "man walk (omitted 'ed') on street". Treatments for morphological deficits in

agrammatic Broca's aphasia have focused on verb infection tasks, subject-verb agreement, tense marking, and the use of subordinate conjunctions (Dickey, Milman, & Thompson, 2008; Shapiro, Shelton, & Caramazza, 2000). Another area of deficit for this population involves difficulty retrieving words.

Lexical Retrieval Deficits

Another linguistic factor that contributes to fluent language production is the lexical retrieval of words. Deficits in lexical retrieval almost always accompany some type of language disturbance associated with brain damage (Friedmann, Biran, & Dotan, 2013). Individuals with agrammatic Broca's aphasia demonstrate deficits that are semantic in nature with difficulty accessing the meaning, difficulty in accessing and producing the correct forms of words. Furthermore, there may be substitution errors or paraphasias or deficits with morphological forms of words. Additionally, individuals with agrammatic Broca's aphasia may demonstrate difficulty with grammatical classes of regular and irregular verbs and grammatical suffixes. Similarly, there may be difficulty with abstract words versus concrete word retrieval. Treatments for lexical retrieval deficits has ranged from semantic feature analyses, confrontational naming tasks, imagery and frequency of words, and action verb naming (Peach & Wong, 2004, Thompson et al., 2013.; Youmans, Youmans, & Hancock, 2011). Also, the grammatical categories such as nouns, verbs, adjectives or prepositions may increase lexical retrieval difficulty in individuals with aphasia. Furthermore, fluent language production

may be limited by poor grammatical structure of language during sentence production and conversation.

Syntactic Deficits

Syntactic disorders are another linguistic factor that compromises fluency in individuals with aphasia. Syntax is the study of the principles and processes by which sentences are constructed in a particular language. Deficits in syntax involve word order. In this study, P2 produced the phrase "brush… teeth….men (The man was brushing his teeth) which illustrates difficulty with number, tense, and word order."   Individuals with agrammatic aphasia often have difficulty producing subject-verb-object sentences; which are the most basic of syntactic forms. Additionally, the sentence type, the number of clauses, and the verb tense can all play a role in the syntax of individuals with aphasia. Agrammatic Broca's aphasia was considered largely a problem of sentence production that reflects an absence of grammatical structure (Jacobs & Thompson, 2000; Thompson, Shapiro, Kiran, & Sobecks, 2003). In addition to sentence production deficits and word retrieval deficits, individuals with agrammatic Broca's aphasia may have difficulty comprehending sentences that are reversible in which two nouns are equally probable candidates for the role of the agent. The agent is the noun phrase (NP) in the sentence (Jacobs & Thompson, 2000). Furthermore, individuals with agrammatic Broca's aphasia may have deficits in sentence production and comprehension when the traditional noun phrase has been moved out of

the canonical subject-verb-object position (e.g. Zack was chased by Quinn). Discourse and conversation are more functional aspects of language that require all areas of language: including sentence production, syntax, morphology, lexical retrieval and comprehension to be intact.

Discourse/Conversation Deficits

Another linguistic factor that can affect fluent language production is the ability to produce discourse or conversation. There are four primary domains of discourse: expository, narrative, persuasion, and description. Discourse requires the comprehension of individual words and sentences as well as the integration across sentence representation to form a coherent understanding of discourse. Individuals with agrammatic Broca's aphasia present difficulty both socially and linguistically processing discourse and conversation due to the nature of the interaction (Cameron, Wambaugh, Mauszycki, 2010; Wambaugh & Ferguson, 2007; Peach & Reuter, 2010; Wilkinson, Bryan, Lock, & Sage, 2010; Lee, Kaye, & Cherney, 2009; Basso, 2010).

Evidence-Based Treatment Options for agrammatic Broca's aphasia

Many studies have shown that speech-language treatment has a significant and in some cases quite large treatment effects in persons with agrammatic Broca's aphasia (Edmonds, Nadeau, & Kiran, 2009). Such studies have involved between-group, and/or within-group comparisons as

well as studies that used single- case study controlled experimental designs.

The primary question of research in aphasia has been to determine the

therapeutic value of behavioral intervention in the recovery of language due to

acquired brain damage. Furthermore, the primary question of interest was

whether aphasia treatment improves language ability. Studies have been

influenced by treatments grounded in the psycholinguistic, cognitive theories,

and neuropsychological theories, and other models of language for oral and

written naming (Martin, Fink, & Laine, 2004; Kiran & Thompson, 2003;

Beeson & Hillis, 2001; Raymer & Rothi, 2001). Additionally, other studies

have examined the treatment effects of naming, word meaning, sentence

production, and comprehension in aphasia (Boyle, 2004; Thompson &

Shapiro, 2005). In the current study, a linguistic approach with an impairment

based treatment such as (VNeST) and a functional approach such as (Script)

are being compared.

There are various treatment options for agrammatic Broca's aphasia.

(Youmans, Youmans, & Hancock, 2011; Youmans, Holland, Munoz, &

Bourgeois, 2005; Thompson, Shapiro, Kiran & Sobecks, 2003; Jacobs &

Thompson, 2000; Friedmann & Shapiro, 2003; Ballard & Thompson, 1999).

Such studies have addressed the training at both the word level and sentence

level. These studies have focused in using treatment options such as a

Semantic Feature Analysis (Peach & Wong, 2004), Treatment of Underlying

Forms (Thompson & Shapiro, 2005), and training of verbs (Thompson et al.,

2013). Thompson et al. (2003) and Jacobs and Thompson (2000) examined whether the training of syntactically complex sentences would result in the generalization to less complex sentences in individuals with agrammatic Broca's aphasia. Additionally, individuals with agrammatic Broca's aphasia had difficulty comprehending sentences in which the noun phrases have been moved out of the canonical (S-V-O) position as in passives or object clauses. The training of syntactically complex sentences involves participants whom will navigate through a series of steps that emphasize the verb and verb argument structure as well as the ability to derive target sentences. In the results, Jacobs and Thompson (2000) and Thompson et al. (2003) explained that sentence production and comprehension are based on the linguistic complexity. Furthermore, the comprehension training resulted in the generalization to production; whereas, production treatment has little effect on comprehension ability. Additionally, the comprehension treatment of trained sentences was superior to the production treatment in facilitating generalization in individuals with agrammatic Broca's aphasia. One limitation of this study was that the participants were not expected to produce the oral reading of written sentences stimuli during comprehension training and so it is possible that production improved because the comprehension treatment contained a production component (Jacobs & Thompson, 2000). Thompson et al. (2003) found that comprehension as well as production improved during treatment. Furthermore, the comprehension treatment of trained sentences

was superior to the production treatment in facilitating generalization in individuals with agrammatic Broca's aphasia. Other types of therapy for chronic aphasia focus on using scripts to ensure participation in a full range of vocational, recreational, and social activities.

Aphasic Severity and Chronicity

Individuals with agrammatic Broca's aphasia benefit from a variety of different treatments, even months and years beyond the time of onset. Recently, emphasis has been put on the need for intensive aphasia treatment to make the long-term neuroplastic changes associated with recovery and rehabilitation following a stroke (Cherney, 2010). Yet, such treatment is not always available. In fact, patients may be eligible for only a limited number of treatment sessions following their acute hospitalization, and the costs of communication treatment delivered to patients with chronic aphasia (beyond 12 months after onset) are not often reimbursable (Cherney, Patterson & Raymer (2011). There is a need to identify treatments that are appropriate and efficacious even when provided at low intensity, and easily administered to individuals with chronic aphasia. On average for treatment intensity, 24-85 hours of treatment were offered as helpful for chronic non-fluent aphasics (Cherney, Patterson, Raymer, Frymark, & Schooling, 2008). In the current study, both participants received both treatments for a total of 18 weeks and two sessions per week which were an hour long each.

Theoretical Framework

Impairment Specific Approach vs. Social-Functional Approach

Two major approaches to aphasia treatment have emerged: One approach was called an impairment specific approach to aphasia treatment; the other approach was called the social functional approach. The impairment specific approach addresses specific linguistic factors such as naming, word retrieval, verb production, morphology, or sentence production during treatment (Raymer et al., 2008; Peach & Wong, 2004; Thompson & Shapiro, 2005; Thompson et al., 2013; Youmans, Youmans, & Hancock, 2011). The impairment specific approach focuses on the impaired language structures or processes and provides direct intervention to improve the weaker areas. The assumption of the impairment specific approach is that treatment of specific aspects of language (e.g. naming) will have broad, spreading effects across language areas and broader communication systems. In the current study, the results of the baseline in-depth assessments helped identify areas of language breakdown and language intervention targets that will bolster the entire language system using a treatment such as VNeST.

The second approach is called the social or functional approach. A social functional approach is based on the individual's communication environment. Under the social functional approach, treatment goals and

procedures are determined by shared decision making where functional language tasks such as conversational discourse are explored. Treatment focuses on functional language tasks such as narratives, sentence production, and conversational discourse (Kagan 1998, Cruice, Worrall, Hickson, & Murison 2003, Kagan et al, 2008).

Bottom-Up Approach vs. Top-Down Approach

The impairment specific approach to aphasia has been described as a "bottom-up approach" (Basso, 2003), in which language components are considered the building blocks of communicative abilities. Bottom-Up Approach has focused on the idea that the weaker areas of language (i.e. word retrieval) are targeted first and this helps to strengthen residual language capabilities (Basso, 2003).

Social functional approaches have been described as "top-down". The social functional approach (Basso, 2003) focuses on the social participation for everyday life activities. Script Therapy is based on a social functional method for communication. A simple comparison of a "bottom-up" to a "top-down approach" might lead to the idea that both approaches will help identify which treatment is best for specific clients to achieve certain outcomes. For the purposes of this study, both an impairment specific approach such as Verb Network Strengthening Treatment (VNeST) and a functional communication approach such as Script Therapy will be analyzed to see what

method of treatment causes change to the pre-to-post outcome measures of rate of speech, SVO production, and error rate.

Script Therapy

Script therapy was chosen as it is a functional approach to aphasia therapy that can facilitate participation in personally relevant conversational activities. Previous studies have utilized group treatment and training of the communication partner to help improve evidence based practice in individuals with aphasia (Elman & Bernstein- Ellis, 1999; Kagan, Black, Duchan, Simmons-Mackie, & Square, 2001). Additionally, treatment studies have also utilized computerized technology to improve language production and comprehension in aphasia.

Script training is a functional approach to aphasia therapy that can facilitate participation in personally relevant activities (Cherney, Halper, Holland, & Cole, 2008; Youmans, Youmans, & Hancock; 2011; Bilda, 2011; Youmans, Holland, Munoz, & Bourgeois, 2005; Cherney, Halper, & Kaye, 2011). Scripts guide and facilitate the identification of participant's conversations and actions involved in social situations. Furthermore, Scripts can provide knowledge including the understanding, remembering, and recalling of the temporal organization of events in a routine activity.

Youmans et al. (2005) conducted a study on two individuals with Broca's aphasia who intensively practiced speaking Scripts as monologues and

conversational contexts. In this study, Scripts were trained one phrase at a time. A cueing hierarchy was used to train new material: phrase repetition, choral reading of passages and then independent production (Youmans et al. 2005). Once a script was mastered, generalization training was implemented. During the generalization phase, monologue scripts were practiced in conversational form with novel conversational partners. Both participants were assessed on their ability to produce automatic speech production as measured by relatively errorless speaking, increased speaking rate, and consistency in using the scripts. Both participants were measured using the percentage of scripts correct, error rate, and the speaking rate. Percentage of script words was the number of script words produced divided by the total number of words in the script. Circumlocutions and substitutions were excluded from the total number of words. The error rate was defined as non-communicative words or phrase repetitions, fillers, pauses of 3 seconds or more, and unrecognizable utterances. Speaking rate was the duration of each script and a word per minute rate was calculated. The results of this study suggest that script training was an effective treatment with individuals with non-fluent aphasia (Youmans et al. 2005). Additionally, both participants produced an increase in the percentage script correct scores and an increase in speaking rate.

Recently, the method of script training has changed from a typed script to a computerized program for script production (Bilda, 2011; Cherney, Halper, Holland, & Cole, 2008; Cherney, Halper, & Kaye, 2011; Cherney, Halper,

Holland, Lee, Babbitt, & Cole, 2007). This computerized treatment is a cost effective medium for therapy and emphasizes the development of conversational skills in everyday life. The computerized script therapy program is called AphasiaScripts (Cherney et al., 2008). AphasiaScripts is a software program using an animated agent that serves as a virtual therapist for Script training. Additionally, the visual therapist is programmed to produce natural speech with correct movements of the articulators for speech. AphasiaScripts provides repeated opportunities for the client to practice individualized conversations that have been pre-recorded. Script training has multiple types of cues including oral motor cues, written words, and choral speaking of the virtual therapist. Computerized script training has three phases including: the client will listen silently to the entire script. Next, each sentence that is part of the client's conversational turn is practiced and the entire conversation is practiced repeatedly in turn taking with the virtual therapist.

The treatment protocol of script therapy involves the development and automatization of personal scripts and then script practice (Cherney et al. 2008). The initial 4 weeks of therapy, are devoted to the development of the conversational scripts by a speech-language pathologist in partnership with the participant with aphasia. The participant will identify and prioritize three script scenarios (Cherney et al. 2008; Cherney et al. 2007; Cherney et al. 2011). Script practice involves baseline measures taken to ensure script reliability. Additionally, the speech-language pathologist will instruct the client on the use

of scripts at home for a minimum of 30 minutes per day (Cherney et al. 2008; Cherney et al. 2007; Cherney et al. 2011). The client is responsible for progressively removing the cues and the client makes weekly visits to the speech language pathologist to ensure script practice is ongoing.

Quantitatively, individuals with aphasia using script therapy in numerous studies were measured based on content including the number and percent of script related words, grammatical complexity including the number of morphemes, nouns, verbs, and modifiers as well as rate (Cherney et al., 2008; Cherney et al., 2007; Cherney, et al, 2011; Bilda, 2011). In previous studies, the use of Script therapy with Broca's aphasia has led to increased content, grammatical productivity, and rate of production (Cherney et al., 2008; Cherney et al., 2007; Cherney, et al, 2011; Bilda, 2011). Additionally, the individuals with agrammatic Broca's aphasia used the scripts to generalize to more social communication exchanges. Furthermore, other types of therapy programs have been found to be beneficial for agrammatic Broca's aphasia including Verb Network Strengthening Treatment (VNeST).

Verb Network Strengthening Treatment (VNeST)

In recent years, verb-centered treatment programs have emerged to address lexical retrieval deficits in sentence production (Edmonds & Babb, 2011). Such verb-centered programs have included sentence completion, cueing hierarchies, picture naming, and semantic feature analysis for verbs and

retrieving verbs. These previous treatment programs emphasize improvements in the retrieval of trained verbs which can result in improved sentence production with those verbs. However, increased lexical production does not necessarily result in improved sentence production. Additionally, generalization of these verb-centered programs has led to mixed findings.

Verb Network Strengthening Treatment (VNeST) is defined as an impairment specific semantic treatment that aims to improve lexical retrieval of content words in sentence context by promoting systematic retrieval of verbs and their thematic roles (Edmonds, Nadeau, & Kiran, 2009). Individuals with agrammatic Broca's aphasia may benefit from the use of predicative components of the semantic representations of concepts. Predicative components are features of nouns that add meaning (Edmonds et al., 2009). For instance, running, leaping, barking, and whining can be predicative components of a dog concept representation (Edmonds et al., 2009). VNeST may also increase the semantic representations of the verbs. The basic task of VNeST is to generate agent and patient pairs to a target verb (Edmonds et al., 2009). For example, these agent and patient pairs could be 'chef' to 'sugar' or 'carpenter' to 'lumber'. Furthermore, the intent of VNeST is to strengthen the connections between the verbs and their thematic roles. Edmonds et al. (2009) conducted a study on four aphasic individuals: two individuals had transcortical motor aphasia and the other two participants had conduction aphasia. All four individuals were evaluated during a connected speech task using a picture

description and Cinderella narrative task to measure their discourse abilities. A Systematic Analysis of Language Transcripts (SALT) (Miller & Iglesias, 2012) was used to measure each participant's number of utterances and mean length of utterances. A complete utterance was considered one that used an agent, verb, and object. Before treatment, participants showed deficits in producing complete utterances from 50% to 62%. Additionally, the number of phonemic and semantic errors were identified and verb naming accuracy varied across participants before treatment. Sentence elicitation pictures were developed for baseline and treatment probes and a control task of adjective retrieval was also used during this study. The treatment stimuli consisted of 10 trained verbs and 6-8 cards for each verb containing 3-4 agents and 3-4 patients related to each verb (Edmonds et al., 2009). Additionally, questions of who, what, where, when, and why and 12 sentences were used that contain the inappropriate agent, inappropriate patient, and thematic reversal. VNeST was administered twice per week for 2-hour sessions. Participants performed the treatment steps that aimed to strengthen the semantic meaning of the target verb and to promote stronger associations between the verb, related agents, and patients.

In the results, the correct production of the agent, verb, and patient in the picture description depicting trained actions increased for all participants except one participant with conduction aphasia. All participants achieved generalization of untrained verbs. Additionally, all participants were able to generalize both treated and untreated verbs. Additionally, all participants

showed an increase in single noun retrieval and three of the four participants improved on agent-verb-patient retrieval in sentences. Three of the four participants showed improvement in the ability to produce utterances containing a relevant subject, verb, and object with an increase in utterances overall. Participant 4 had conduction aphasia and did not show improvements in connected speech on any measure. Overall, VNeST does generalize to nouns and verb retrieval in sentence production.

Edmonds and Babb (2011) examined the effects of VNeST with two participants with more moderately severe Broca's aphasia. The treatment protocol was the same as in Edmonds et al. (2009) as the participants were rated on their single word naming of objects and actions, evaluated on sentence production, evaluated on the production of correct information units in discourse, and the ratings of functional communication as based on the Communicate Effectiveness Questionnaire (CETI; Lomas et al., 1989). In the results, participant 1 exhibited a small increase in noun retrieval; whereas, participant 2 resulted in a significant increase in retrieval of nouns. Additionally, both participants exhibited an increase in words from pre-to-post treatment in their production of correct information units and their use of neologisms decreased. On the CETI scale, both participants demonstrated a significant increase in ratings of functional communication (Edmonds & Babb, 2011). A few limitations of this study included the necessity to include the relationship between verbs and their thematic roles, treatment intensity and duration is

another limitation as well as the participant factors, generalizability outcomes, cognitive linguistic factors, and access to the communication partners.

Problem

There is limited previous research on individuals with agrammatic Broca's aphasia and their ability to consistently produce sentences. In previous research, there were many approaches to treatment with individual with agrammatic Broca's aphasia, but few have been cost effective and addressed treatment of language skills in realistic contexts. Additional factors that may contribute to the variability with this agrammatic Broca's population are length of time between onset of neurological event and the length of time of treatment. For some people, aphasia will be temporary, resolving in the first few days or even hours after their stroke or brain injury. Others will have a long recovery of months or years. Some people may improve to a degree in the first few months, but will still live with a severe aphasia that affects their ability to communicate for the rest of their lives. It is rare for people to make no improvement at all.

The typical pattern of recovery is for aphasia to be at its worst initially, with spontaneous recovery occurring most rapidly in the first few days, weeks and even months. Spontaneous recovery is a term used to describe the improvement that happens as the brain heals from a stroke or brain injury. Traditionally, experts have advised people that there was a finite period of time

during which the brain would heal, after which improvement was no longer likely. While there is disagreement over the length of time, spontaneous recovery may occur within the first year. There has long been general agreement that there was a "window of opportunity" for improvement to be capitalized on by therapy, after which people improved mainly by adapting to their aphasia (Smania et al.,2010). Few studies have used these two treatments: Script Therapy and Verb Network Strengthening Treatment with individuals with aphasia.

Aim of the Study

The aim of this study was to determine the efficacy of the two treatment approaches: Script and VNeST for the agrammatic broca's aphasic population.

Significance of the Study

In the current healthcare situation, clinicians are expected to make informed decisions in the choice of treatment that yields results at a lower or minimal cost. Therefore, it is important from an evidence based practice perspective to explore further treatment options. For the purposes of this research, what remains unclear is the effectiveness of these two treatments on language outcomes at the word, sentence and discourse level measures in individuals with agrammatic Broca's aphasia. The comparison of the two treatments in this study has not been previously researched with individuals with agrammatic Broca's aphasia. In examining the feasibility of combining

treatment approaches for individuals with agrammatic Broca's aphasia, it is important to use of a single subject multiple-baseline alternating treatment across participants' design that allows for conclusions about cause and effect, interval validity, and feasibility.

Research Questions/Hypotheses

1.) RQ1. Does the combination of Script and VNeST interventions improve language outcomes in individuals with chronic agrammatic Broca's aphasia during standardized assessment measures?

H1a. Participants will increase language skills including naming, comprehension, narrative production and cognitive skill areas from pre-treatment to post-treatment.

2.) RQ2. Do the participants show gains in word level, sentence level, and discourse level measures obtained from baseline to maintenance phases?

H2a. Participants will show gains in rate of speech, SVO production, and decrease error rates obtained from language samples at baseline through maintenance phases.

3.) RQ3. What are the relative effects across interventions on word, sentence, and discourse level measures obtained from language samples?

H3. Large effect sizes will be found on word, sentence, and discourse level measures across interventions.

3a.) RQ3a. What are the relative effects for each participant on word, sentence, and discourse level measures across interventions?

H3a Large effect sizes will be found on word, sentence, and discourse level measures for each intervention per participant.

4.) RQ4. How does Script compare to VNeST intervention for improving language outcomes in individuals with chronic agrammatic Broca's aphasia?

H4a. VneST will be more efficient in improving language outcomes for the chronic agrammatic population.

Chapter III

METHOD

Study Design

This study used a single subject multiple baseline alternating treatment across participants' design. This study design included four phases: baseline, treatments 1 or 2 and then reversed, post treatment and a 4- week maintenance phase to reassess probe tasks. Two participants diagnosed with agrammatic Broca's aphasia by the primary investigator during inclusion testing participated in the study. Both participants entered the baseline treatment and the treatments were counterbalanced against one another. Weekly randomized probe tasks (video, picture description/sequencing, and procedural narratives) were administered during the second session of each week during the study. Additionally, a picture description probe task was administered at baseline, between treatments, and post treatment to control for learning effects.

Single Subject Designs

Due to the limited number of individuals with aphasia and the heterogeneity of the disorder, single subject designs are often the nature of research in this area. Most treatment studies in aphasia have less than five participants. Use of single subject multiple baseline alternating treatment

designs allow for the careful selection of study participants for the specific

nature of their language impairment, precisely describing the components of

treatment as well as the outcome measures, and carefully gathering reliability

data. Furthermore, through the use of single subject designs, researchers

have discovered treatments that are effective for patients with certain types of

language impairments (Thompson, 2006, Kiran & Thompson,2003; Edmonds

et al., 2009; Martin et al., 2004, Beeson & Robey, 2006).

Knowing the effects of specific types of treatment for patients with

certain language impairments as well as understanding the extent to which

these treatments result in generalized language use is important particularly

in the current health care climate, which imposes limitations on the treatment

that can be provided. Treatment outcome research measures changes during

or after the treatment process and addresses a variety of questions including

cost of treatment, quality of care, and achievement of functional change in the

client (Olswang, 1993). The outcome or benefits of treatments are

documented as "real world" conditions. Demands for data that show

significant, cost-effective changes in client behavior following interventions

have resulted in an increase in outcome research. Single subject designs are

less focused on exploring how treatment alters behavior but rather the

treatment is associated with important changes in a client's life that

contributes to ecological validity (Schwartz, 2010, Olswang, 1993, Robey,

2004). Treatment outcome research yields meaningful effects when the

intervention comes packed into a less costly program (Fey & Finestack, 2009). Additionally, treatment outcome research can help increase external validity and generalizability to real-world clinical applications and identity specific treatment benefits for smaller populations (Robey, 2004).

Feasibility of Single Subject Multiple Baseline Designs. The principle purpose of feasibility research has less to do with measuring treatment outcomes than with evaluating the clinical viability of untested interventions. Publications of feasibility research is pivotal to the development of a strong research based that helps to support evidence based practice. Additionally, publications of these works can encourage discussions across research including advances in interventions, validating outcome measures, and strengthening research designs. Effectiveness studies or treatment outcome research can evaluate the effects of efficacious treatments across broader, more typical populations and under broader, more typical clinical conditions (Fey & Finestack, 2009; Schwartz, 2010; Olswang, 1993).

The feasibility of multiple baseline designs incudes that a withdrawal of an effective treatment is not required to demonstrate the functional relationship between independent variables and dependent variables. Furthermore, the generalization of the behavior change is monitored through the design. Replication of multiple baseline designs can provide evidence that the data paths change in predictable manners from baseline to intervention through maintenance phases.

Effect sizes and Single Subject Designs. An effect size is computed for each empirical study investigating a specific treatment and then is averaged across studies to provide a summary statistic on the interventions effectiveness (Rogers & Graham, 2008). Single subject designs can be used to test whether a treatment is responsible for observed changes in performance. Additionally, Rogers and Graham (2008) discuss the major threats to interval validity are controlled by within and between subjects' comparisons, and external validity is enhanced through systematic replication. In single subject designs studies, participants serve as his or her own controls with performance prior to as well as during and/or after intervention which is repeatedly measured to establish performance patterns across baseline through maintenance phases which was used in this study.

Experimental control. One method for establishing experimental control involves the introduction and withdraw of treatment. A multiple baseline design involves implementing a stable baseline of performance followed by treatment to determine changes in the dependent variable, followed by the withdrawal of treatment to determine whether performance returns to baseline levels, followed by treatment again. Multiple baseline designs involve the staggering of both within and between subject comparisons. In multiple baseline studies, researchers establish a baseline pattern of performance for each participant, then treatment is implemented

with one participant to determine whether it influences the performance in a predictable fashion (Rogers & Graham, 2008).

To demonstrate interval validity in single subject designs, performance within the same participants is compared before and during treatment implementation (Koutsoftas, Harmon, & Gray, 2009). In a multiple baseline across participants' design, experimental control is demonstrated when performance changes for the participants who begin different treatments (McReynolds & Thompson, 1986). With regards to this study, both the weekly probe tasks and the mid-treatment picture description tasks were administered for further demonstration of experimental control.

Institutional Review Board

Completed applications were submitted to Hackensack University Medical Center and LaSalle University Institutional Review Boards (IRB). Approvals from both Institutions were received (Appendix A & B). After obtaining IRB approvals, participant recruitment started. Hackensack University Medical Center and Seton Hall University IRB approval # Pro00006239 (continuation approved on 4/27/17) and LaSalle University IRB approval # 15-03-009.3-17-RC (continuation approved on 3/27/17).

Timeline for Study
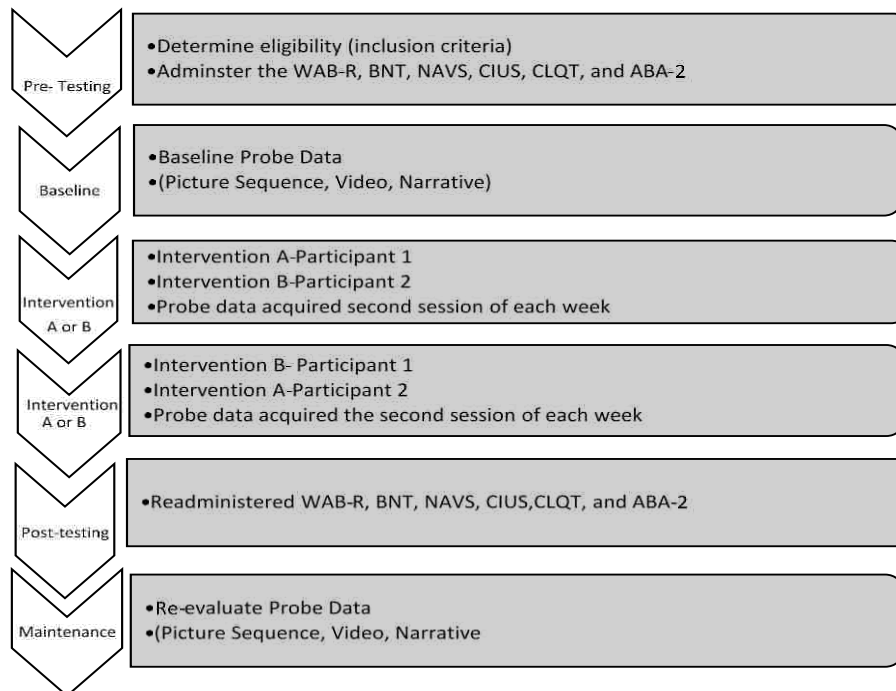
Figure 1. Timeline for study over the course of 26 weeks

The length of the study was 26 weeks long. After signed consents, the first two weeks were devoted to pre-treatment testing and baseline probe measures. After the baseline probes measures were administered, both participants were randomly selected through a coin toss and administered alternate treatments. P1 received Script therapy and then VNeST. P2 received VNeST then Script. After the first nine weeks, the treatments were stopped and both participants took a two-week break from treatment. Once

the break was over, the participants were re-evaluated using the mid-treatment probe and the second alternate treatment was implemented. After 18 weeks, the final probes were administered and the four-week maintenance probe measures were assessed.

Method of Recruitment

All recruitment efforts respected participants' right to privacy and confidentiality in the research site. Speech-language pathologist who cover the LaSalle University Clinics approached the potential participants and asked if they were interested to participate in the study. Once the participant agreed to the study, the principal investigator explained the details of the study. The patient must be competent of understanding the facts about the research and were able makes decisions. The primary investigator delivered all the necessary information about the study, including the goals, benefits, and potential risks.

The participants who agreed to participate in the study received a consent form. The consent forms stated the researcher's affiliations with Seton Hall, Hackensack, and LaSalle University, the purpose of the research, expected study duration, rights of the patients, benefits and risks and the description of the procedure. Both participants signed the informed consent form.

Participants

Sampling Procedure

Two participants were recruited from the LaSalle University Speech-Language-Hearing-Community Clinic in Philadelphia, PA. This study used a convenience-sampling technique where participants were selected based on their accessibility to the research and type of aphasia.

Inclusion Criteria

The participants met several inclusion criteria including (a) diagnosis of aphasia quotient of <50 on the Western Aphasia Battery (WAB-R; Kertesz,1982), (b) monolingual English speaking, (c) right handiness prior to stroke, (d) considerable verb retrieval deficits as diagnosed from the Northwestern Assessment of Verb Production Battery (NAVS; Thompson, 2002), (e) negative history of diagnosed learning disorder, and (f) no worse than a composite score of a mild deficit on the Cognitive Linguistic Quick Test (CLQT; Helm-Estabrooks, 2001) (g) Both participants were in the intended age ranges of 25-65 years old. Additionally, the Apraxia Battery for Adults 2nd Edition (ABA-2; Dabul, 2000) was administered to determine the presence or absence of speech, oral or limb apraxia. All participants earned a high school diploma or better. Aided visual acuity was judged within normal limits. Hearing was unaided and judged as within normal limits. Participants were not to be enrolled in any other speech and language therapy at the time of the baseline

testing phase of the study. Both participants demonstrated adequate reading of single words.

Exclusion Criteria

Three exclusions for this study included participants with greater than a mild cognitive impairment including participants with a history of previous learning disability, participants already enrolled in treatment, and participants with other types of aphasia. An additional participant was evaluated and excluded due to the type of aphasia.

Participant Demographics

P1 was a 32- year-old right-handed woman with 16 years of education. In 2007, P1 was diagnosed with a craniopharyngioma and received a partial resection. At that time, there were no reported problems with speech and language due to the tumor. Twenty months before beginning the study, P1 had a left hemispheric stroke. According to CT scans, she sustained a massive left middle cerebral artery stroke (MCA) extending from the striatocapsular territory extending to the frontal lobe. Subsequent to her stroke, she underwent a craniotomy to relieve pressure. Prior to her stroke, P1 was a college student finishing all but one class as a Criminal Justice Major. Immediately after her stroke, P1 received speech and language therapy at a rehabilitation hospital, but discontinued it eight months prior to participating in the current study. Additionally, she had a history of seizures

after the stroke with which she takes the medication Gabapentin. P1 did not report any seizure activity six months prior to the stroke, during the study or after the maintenance period. P1 passed the hearing screening prior to the study at 30 db.

P2 was a 46-year-old right-handed male with 16 years of an education. Twenty- six months prior to the study, he had a large severe MCA with mass effect from the parenchymal edema the invoking the temporoparietal region as noted from his CT scan. P2 passed the hearing screening at 35 db. Prior to his stroke, P2 worked as a business manager. P2 received speech therapy for approximately 15 months after his stroke, but he had discontinued this therapy six months prior to enrollment in this study. This participant had a medical history of high blood pressure and depression after the CVA.

Table 1.

Participant Demographic Information

Participant	Age & Gender	Years of Education	Handedness Of Subjects	Years since Onset	Site of Lesion	Occupation Prior to Illness
P1	32, Female	16	Right	20 months	MCA	Student
P2	46, Male	16	Right	26 months	MCA	Manager

Procedures

Prior to the initiation of the study, approval for all procedures was granted by the institutional review board associated with the primary investigator's affiliated universities (LaSalle University and Hackensack University Medical Center). The following section outlines: a) Language testing to determine eligibility, b.) Post-treatment testing, c.) Procedures to assess pre-to-post language measures.

Pre-treatment Language Testing

All participants underwent initial eligibility testing including: The Western Aphasia Battery-Revised (WAB-R; Kertez, 2006), The Cognitive Linguistic Quick Test (CLQT; Helm-estabrooks, 2001), the Apraxia Battery for Adults (ABA; Dabul, 2000), the Boston Naming Test (BNT; Kaplan,

Goodglass and Weintraub, 1983), The Northwestern Verb Production

Battery/The Northwestern Assessment of Verbs and Sentences (NAVS;

Thompson, 2002), and the use of the elicitation materials from Nicholas and

Brookshire, 1993). Additionally, all pre- and post-treatment testing was

conducted by the primary investigator.

Table 2.

Pre-Treatment Assessment Scores

	WAB-R	BNT N =60	NAVS N=22	CIUS	CLQT	ABA-2
P1	46.5	31	11	14	183 Attention, 160 Memory, 31 Executive Functions, 15 Language, (Severe) ,91 Visuospatial Skills	Mild
P2	42.5	30	8	10	191 Attention,181 Memory,24 Executive Functions 11 Language-(Severe), 83 Visuospatial skills	WNL

Testing Materials (Reliability and Validity)

Western Aphasia Battery-Revised (WAB-R, Kertesz, 2006). All

participants' aphasia profiles were obtained by administering the WAB-R

(Kertesz, 2006). This standardized test was used to obtain an aphasia

quotient, which is a composite score that includes picture description, auditory

comprehension, repetition, spontaneous speech, and naming tasks.

Participants were identified as having agrammatic aphasia which includes

difficulty with language production characterized by short utterance lengths

with one to two words, relatively adequate comprehension, poor repetition,

reduced fluency, and decreased naming.

Reliability and Validity of Western Aphasia Battery-Revised. The

WAB-R was standardized on 4 populations:150 patients of all etiologies

including 365 aphasics and 161 total controls. Criterion Validity indicated the

extent to which a test may be used to estimate an individual's standing in

respect to their disability with a Pearson Correlation Coefficient score of (.96),

an internal consistency score of (.91) indicating a high internal

consistency. An intra-rater reliability correlations of 10 tests administered

indicated that correlations were obtained for each subsection and judged as

high. Interrater reliability (range .98 to.99) correlations were consistent over 8

raters. For test-retest reliability, the WAB-R yielded a score of (.99). A

criterion for differentiating aphasics from controls is validated-high construct

validity, test-retest reliability, intrarater, and interrater reliability was shown.

Boston Naming Test Reliability and Validity (BNT; Kaplan, Goodglass & Weintraub, 1983). This test consisted of a 60- item confrontation naming test. All participants were administered the BNT to rule out confrontation naming deficits. The participants in the study scored less than 30 on the Boston Naming Test. An interjudge reliability on 12 out of 60 BNTS scored from 85.9%-95.2%. The interjudge reliability score was (.98). Intercorrelation scores were (.81) for the BNT.

Cognitive-Linguistic Quick Test (CLQT, Helm-Estabrooks, 2001). This assessment assessed five cognitive domains: attention, memory, language, executive functions, and visuospatial skills. The CLQT version provides a standardized scoring system that permits analysis of language, visuospatial planning skills, and conceptualization of time. The CLQT was normed on 171 non-clinical cases and 38 clinical cases, including TBI.

Reliability and Validity for the CLQT. For test-retest reliability, the CLQT was administered to 46 examinees on 2 separate occasions. The test-retest coefficients ranged from 0.03 and 0.81 for each subtest and from 0.61 to 0.90 for cognitive domains. Interscorer agreement was (.86) among two scorers. Test content validity was rated as (.74) for found for the composite severity rating and each subtest.

Northwestern Assessment of Verbs and Sentences (NAVS, Thompson, 2002). The NAVS was designed to examine comprehension and production of action verbs, production of verb argument structure in sentence

contexts, and the comprehension and production of canonical and non-canonical sentences in individuals with language disorders resulting from neurological disease. There were five subtests including the Verb Naming test (VNT), the Verb Comprehension Test (VCT), the Argument Structure Production Test (ASPT), the Sentence Production Priming Test (SPPT), and the Sentence Comprehension Test (SCT). A total of 103 individuals with aphasia participated in standardization. Fifty-five presented with non-fluent aphasia and 48 were fluent. Aphasia type was determined by the WAB-R. For reliability data from 44 of the 103 individuals with aphasia were used to examine internal reliability and external validity. Correlational analyses were conducted on all items across sentence types. Participant performance on all items on the VNT indicating a high degree of internal reliability. The same patterns were demonstrated in the SPPT and the SCT with significant correlations between all individual items. For interrater reliability, no significant differences were found across raters per subtest. (P=.919 - p=.999). During the assessment of external validity, significant correlations were found between all NAVs subtests and WAB-R aphasia quotient scores. The NAVS appears to be a valid measure for verb and sentence comprehension and production.

Correct Information Units/agrammatic profile (CIUS, Nicholas & Brookshire, 1993). The participants' agrammatic profiles were determined for eligibility by using narrative speech samples from the elicitation materials from

Nicholas and Brookshire. To assess interjudge reliability, the two scorers who scored the transcripts for this study both independently scored a systematically selected, representative sample of the transcripts (10 speech samples for each of 6 non–brain damaged and 6 aphasic subjects). The aphasic subjects were representative of the group in severity and type of aphasia. Four of the subjects exhibited fluent aphasia and 2 exhibited nonfluent aphasia. Point–to–point interjudge percent agreement for number of words and number of CIUs was calculated with the following formula: [total agreements/ (total agreements + total disagreements] x 100]. Interjudge reliability exceeded 98% for words and 90% for CIUs for all 12 subjects and did not appear to be strongly correlated. Intrajudge reliability exceeded 99% for words and 95% for CIUs for all 6 aphasic subjects.

Apraxia Battery for Adults-2 (ABA-2; Dabul, 2000). All participants were administered the ABA-2 (Dabul, 2000). The ABA-2 was administered to determine the presence or absences of speech, oral or limb apraxia.

Reliability and Validity of the Apraxia Battery for Adults. Test reliability, investigated by the coefficient alpha, was rated as high (reliability coefficients of .83 to .99 were obtained for all subtests). Content, criterion-related validity, and construct validity were studied through a review of the literature, item analysis, comparing the results of the ABA-2 to the Porch Index of Communicative Ability, comparing differences in scores on the ABA-

2 of various subpopulations, and examining the correlations of the subtests.

Results indicate that examiners can use the ABA-2 with confidence.

Experimental Treatment Tasks

Table 3.

Counterbalanced Treatments per Participant

P1	P2
Script Therapy: weeks 1-9	VNeST: weeks 1-9
VNeST: weeks 9-18	Script Therapy: weeks 10-18

Procedures for Script Therapy Treatment

   Script Therapy Stimuli. Prior to the treatment phase, all participants

worked in conjunction with the primary investigator to develop the three script

topics including a hobby, a vacation and a phone call scenario. Each topic

was meaningful, relevant, and matched to each participant's communication

level. The communication level was determined by the participants' ability to

produce short versus more complex sentences as well as word retrieval.

      After the scripts were documented, three phases occurred for each

participant to learn the script. First, the participant listened to the entire script

as read aloud by the speech-language pathologist. Second, each sentence

or phrase or conversational turn was practiced repeatedly. Third, the

conversation was practiced with the primary investigator while cues are

provided based on the participants needs. These cues include a written word cue, hearing the primary investigators' voice during choral speaking, and watching oral motor movements (Cherney, Halper, & Kaye, 2011). These cues faded over time so the participants practiced the conversation with the primary investigator, without cues, as in a real conversation. All participants practiced the three individualized scripts for three weeks each for a total of nine weeks. Additionally, all participants were asked to practice at least 30 minutes a day, six days per week for a minimum practice time of three hours a week. The Script data per participant can be found in figures 1 & 2.

Treatment structure for Script Therapy. Each participant was seen individually for two 60 minute sessions for nine weeks. Treatment sessions were structured to allow at least three 10-minutes episodes of practicing scripts, interspersed with approximately four brief periods of relaxed open conversation. At the beginning of each session, the participants were audio- and video-recorded while practicing the scripts or the targeted verb sentences. As the scripts became mastered, treatment sessions ended with approximately 10 minutes of conversation practice to promote flexible use of scripts. The home practice sessions were prescribed twice daily for 15 minutes each during which the participants practiced their scripts via a tape recorder. The participants reported consistency of home practice weekly through daily text messages to confirm practice.

Blocked Practice. Scripts were trained one phrase at a time, using a blocked practice approach to promote acquisition. The cueing hierarchy consisted of clinician modeling the target phrase, clinician and participant modeling in unison, clinician and participant productions of the phrase in unison, clinician and participant productions of the phrase in unison with clinician fading participation, independent productions by the participants with written cues and no cues.

Random Practice. When three phrases of scripts were produced independently without cuing or support with 90% accuracy, random practice of scripts will be initiated for these acquired phrases. First, the clinician randomly selected and pointed to cue cards used to train the phrases. Participants were instructed to produce each phrase only once before moving on to the next phrase. Feedback on the accuracy of speech sound production and articulator placement/positioning was provided in a summary fashion after each episode of random practice.

Procedures for VNeST Stimuli Development

Stimuli consisted of 10 cards containing the names of 10 target verbs, six to eight cards for each verb containing three to four agents and three to four patients that formed three to four pairs related to each verb. Additionally, five cards containing the words who, what, where, when, and why and 12 sentences for semantic judgment and 12 sentences containing the target verb broken into four categories:

A. correct ("The designer measures the room."),

B. inappropriate agent ("The infant measures the lumber.),

C. inappropriate patient ("The chef measures the television"),

D. thematic reversal ("The room measures the designer")

(Edmonds & Babb, 2011).

VNeST was administered two times per week for two one hour sessions for a total of 9 weeks. During treatment, both participants were asked to produce orally three to four thematic pairs (e.g. carpenter and lumber) for a provided verb (e.g. measure). When the participants were unable to produce a word, written options on cards were provided. In this protocol, the participants were to generate three to four agent pairs, then the participants would read each agent-patient pair aloud (the verb was not read aloud) and then chose one answer to a wh-question. During treatment, participants were asked to produce orally three to four thematic role pairs (e.g. carpenter and lumber) for a provided verb (e.g. measure). When they were unable to produce a word, written options on cards were provided (some appropriate and some foils). Participants were encouraged to provide at least one personal pair (e.g., dad/boat for drive), and responses could change from week to week. In the original protocol (i.e., Edmonds et al., 2009), after generating three to four appropriate agent-patient pairs, participants read each agent-patient pair aloud (the verb was not read aloud) and chose one to answer wh-questions about it (e.g. when, where, or why). Following the

protocol, when the participants were unable to produce thematic role pairs for a provided verb; they were allowed to write their responses. Criterion for ending treatment is met when participants produced a minimum of 24 relevant agent-patient pairs (80% accuracy) during treatment Step 1 (e.g., for measure, acceptable pairs could include chef/sugar, wife/windows, or designer/room).

Treatment session structure for VNeST

During administration, probe pictures were presented pseudorandomly with semantically related verbs (e.g.bake/fry) in non-sequential order. For each picture, participants were instructed to make a sentence and include him/her, the action, and this (while pointing to the agent [carpenter], verb [measure], and patient [stairs]). Prompts were not provided unless the participant produced a general word for the target (e.g. cut instead of slice or man instead of carpenter), for which a prompt for a more specific word was given. The VNeST data per participant can be found in figures 2. & 3.

Post-Treatment Testing

The measures assessed during initial testing were repeated during the post-treatment session immediately following the cessation of treatment. Tests results were analyzed from pre-to post treatment to address single lexical retrieval using the Western Aphasia Battery-Revised (WAB-R), the Boston Naming Test, (BNT; Kaplan, Goodglass & Weintraub,1983), the Northwestern Assessment of Verbs and Sentences (NAVS) (Thompson,

2002). Finally, to gauge lexical retrieval in connected speech were evaluated with 10 elicitation materials from Nicholas and Brookshire (1993).

The participants underwent post-treatment testing to 1) To determine treatment gains in rate of speech or words per minute, subject-verb-object production or sentence level production and error rate or discourse, 2) Assessment generalization of untrained verbs in VNeST. 3) Assess changes in their Aphasia Quotient on the (WAB-R). Additionally, a four-week post-treatment session was conducted to evaluate the maintenance of treatment gains in production of scripts and naming of trained subject, verb, and objects combinations in VNeST.

Table 4.

Post-Treatment Assessment Scores

	WAB-R	BNT N =60	NAVS N=22	CIUS	CLQT	ABA-2
P1	69.9	44	17	15	190 Attention, 165 Memory, 33 Executive Functions, 22 Language moderately severe score in language, 98	Mild

					Visuospatial Skills	
P2	50.3	34	10	12	193 Attention, 185 Memory,30 Executive Functions, 20 Language severe score in language, 89 Visuospatial Skills	WNL

Treatment Fidelity

Treatment fidelity refers to the methodological strategies used to monitor and enhance the reliability and validity of behavioral interventions (Robey, 2004). For script therapy, each participant was evaluated after each session on the following: percentage of script related words, number of morphemes, number of nouns, number of verbs, and number of modifiers. The VNeST data included the percentage of verbs, percentage of objects, percentage of subjects, the wh-questions, and semantic judgment.
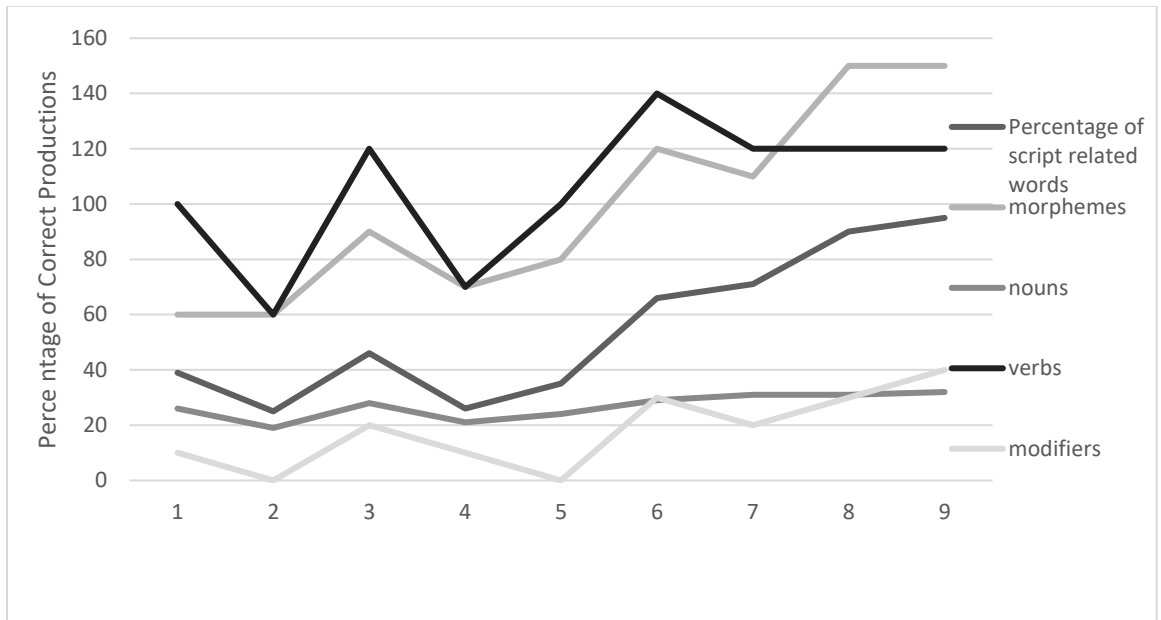
Figure 2. Script Therapy data for P1.
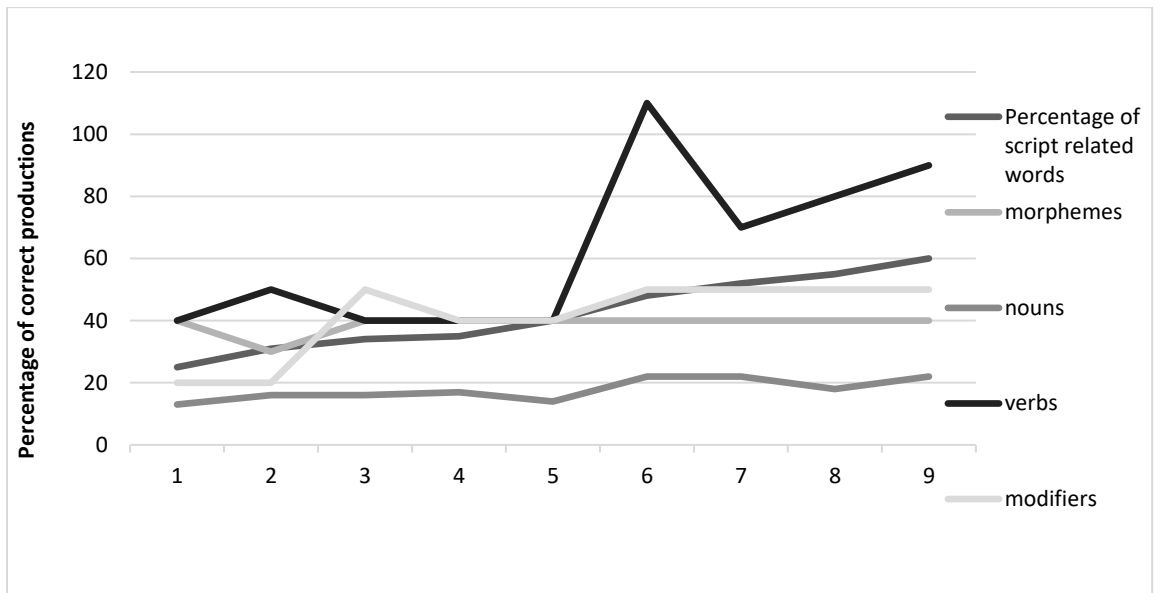
Figure 3. Script Therapy Data for P2.
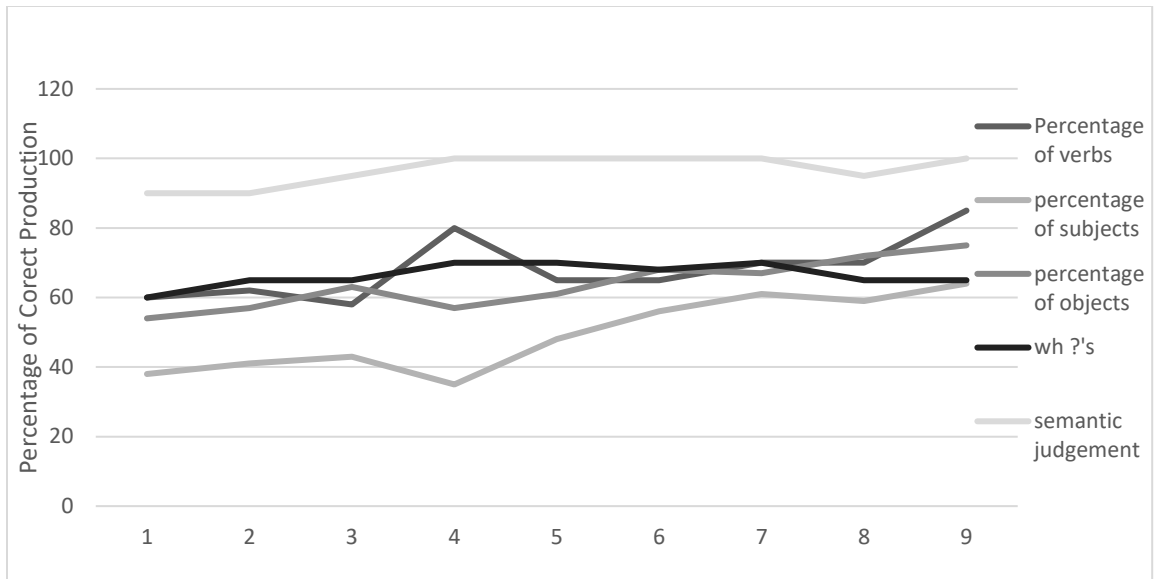
Figure 4. VNeST Data for P1.
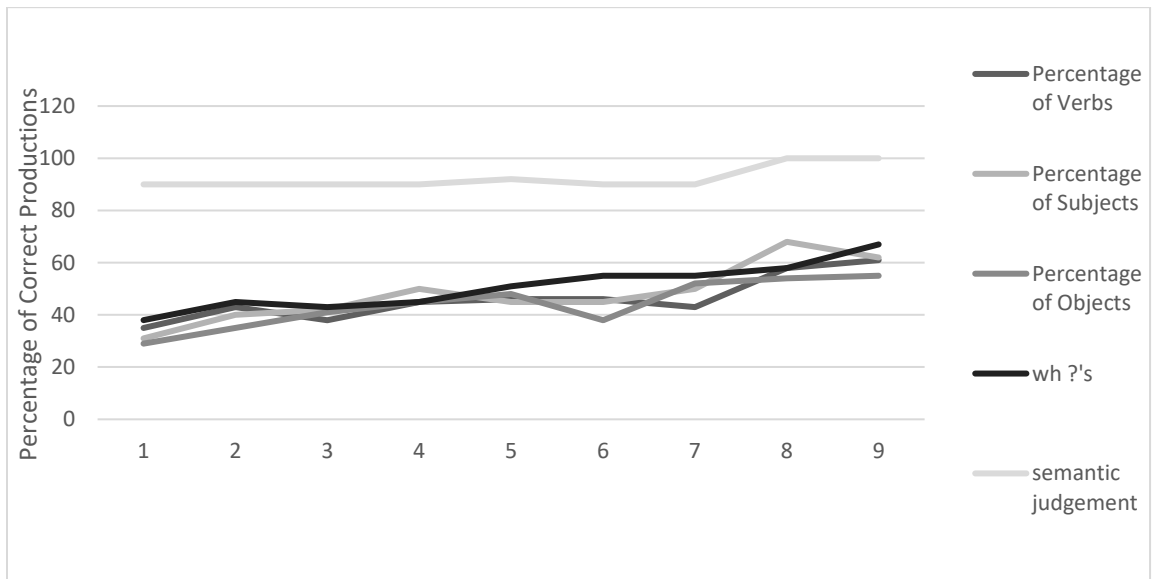
Figure 5. VNeST Data for P2.

Reliability

Reliability was determined for a number of measures by the author and three trained research assistants. Reliability was determined by dividing the number of responses agreed upon by the total number of responses scored.

Pre-to-post-treatment language measures. Inter-rater reliability was conducted on pre-to-post treatment language measure. A reliability score of (0.97) was attained on all pre- and post- treatment measures. Scoring agreement was (0.92).

Treatment. Three trained master's level research assistants watched 55% of all sessions to ensure adherence to treatment protocol. Inter-rater reliability scores were calculated for each of the variables. Approximately, 60% of the probes from baseline, treatment, and maintenance phases were rescored by the three research assistants. Prior to the initiation of the study, the three research assistants were trained on Script and VNeST treatment protocols. The research assistants were also trained on the Systematic Analysis of Language Transcriptions (SALT; Miller & Iglesias, 2012). Using the Pearson Correlation Coefficient, agreement in responses, and scoring among three research assistants was (.94) on all post- testing measures.

Treatment Reliability for Script. Pre-, Post- and maintenance Scripts were audiotaped and transcribed and compared with target Scripts for content, grammatical productivity, and rate of Script words produced. All

Scripts were transcribed by the primary investigator and one of the three master's level research assistants. Inter-rater reliability of all script therapy sessions were rescored and transcribed independently by the three masters level research assistants which the score was (.93) using a Pearson Product Correlation Coefficient on all script variables.

Treatment Reliability for VNeST. To ensure the VNeST treatment protocol was conducted consistently, the same three master level research assistants participated in 55% of all sessions. Treatment reliability was followed approximately (.95) using a Pearson Product Correlation Coefficient with the VNeST protocol. For inter-rater reliability, all VNeST sessions were rescored and transcribed independently by the three masters level research assistants which the agreement score in responses and scoring among two research assistants was (.91) on all VNeST variables.

Measures

Probe measures

The probes measures consisted of short language samples including picture sequences/descriptions, short novel videos, and procedural narratives. All probes were randomly assigned during the second session of each week. For all probes a series of prompts were offered to help elicit more language. For each probe, participants were instructed to "make a sentence and include what he or she is doing in each picture, or tell me what is

happening, and please tell me more, tell me the steps involved in. A randomized list of six prompts for each probe were used throughout this study.

Pre-, mid-, and post- treatment probes. Both participants were measured at pre- and post- treatment using picture narrative tasks from the Nicholas and Brookshire Picture cards. The Cookie Theft Picture from the Boston Diagnostic Aphasia Examination (BDAE; Goodglass & Kaplan, 1972) was used to assess the mid-treatment probe.

Pre-to-Post Treatment Measures (Dependent Variables)

The dependent variables include rate of speech, subject- verb-object production (SVO), and error rate. Rate of speech was determined by words per minute. Addtionally, rate of speech is an example of a word level measure. Subject -verb- object (SVO) production was based on all sentences that contained the correct S-V-O structure (not including grammatical correctness- use of functor words). S-V-O production is an example of a sentence level measure. Error rates are an example of a discourse level measure. For error rates, this was determined by the number of paraphasias, (phonemic/semantic), repetitions, omissions, substitutions, I don't know responses/no responses, incomplete utterances, morphological errors, interjections (um), and perseverations. All outcome measures were assessed over a two-minute time period during probe tasks. The probe tasks consisted

of a short video that was viewed on an Ipad approximately two minutes in length, a picture sequence (3-4 pictures), or procedural narratives.

The Independent variables included the two treatments of Script therapy and VNeST. The generalization of these variables was measured on the three dependent variables during the second session of each week.

Risks and Benefits

Participating in the study did not put the participants at any potential risk or discomfort. Participation did benefit the participants directly. Participation was completely voluntary and the participants had the choice to stop and withdraw from the study at any time.

Ethical Considerations

The principle investigator and three master's level research assistants were the only individuals to have access to the participant videos and transcripts throughout the study and data collection.

Equipment/Instruments: Video/Audio Taping

All participant data were collected in the LaSalle University Speech-Language-Hearing Community Clinics. Video and audio taping was collected using the Logitech Webcam software were used to record both video and audio sample of clients. An additional Sony Digital Voice recorder (ICD-BM1VTP) were used to record all samples during sessions. The data was

collected via digital video and audio recorder at the beginning of each session and later transcribed. All videos, audio recordings, and transcribed samples were kept on a password protected external hard drive in a locked office. All collected data will be kept for at least 3 years after project completion. All participants were de-identified after they consent to the study by an alpha-numeric code will be used in place of their names. The informed consent form will be the only place where their name appears and these will be locked in a file cabinet in an office to ensure no connection can be made between the subject and all data. After the participants consented to the study, they were assigned an alpha numeric code which was placed on all materials instead of their name. All data will be kept in locked in a file cabinet in which is password protected. The keys for the file cabinet were also under lock and key. All electronic video/audio tapes were stored on an external hard drive which was locked in a cabinet in the primary investigator's office.

Statistical Analysis

In this study, both dependent and independent variables were analyzed using SPSS statistic software version 24.

Chapter IV

RESULTS

Study Objectives

The objectives of the current study were to determine which of the two treatments: Script and/or VNeST were beneficial in the improvement of the word, sentence, and discourse level measures.

Data Analyses

To answer the study predictions and research questions, the following statistical methods were used. The first analysis included the variability on the pre- and post-treatment scores from baseline to maintenance. Secondly, each of the three outcome measures: (rate of speech, SVO, and error rate) were analyzed from the baseline to maintenance stages to determine improvement. Third, using the Busk and Serlin's (1992) $d2$ effect size formula, the outcome measures were evaluated according to the magnitude of change from baseline to maintenance tasks. Lastly, using the Percentage of Data Exceeding the Median Scores (PEM), both participants were evaluated for the effectiveness of the interventions.

Each research question and hypothesis is reiterated below, followed by the results for each question.

1.) RQ1. Does the combination of Script and VNeST interventions improve language outcomes in individuals with chronic agrammatic Broca's aphasia during standardized assessment measures?

H1a. Participants will increase language skills including naming, comprehension, narrative production and cognitive skill areas from pre-treatment to post-treatment.

2.) RQ2. Do the participants show gains in word level, sentence level, and discourse level measures obtained from baseline to maintenance phases?

H2a. Participants will show gains in rate of speech, SVO production, and decrease error rates obtained from language samples at baseline through maintenance phases.

3.) RQ3. What are the relative effects across interventions on word, sentence, and discourse level measures obtained from language samples?

H3. Large effect sizes will be found on word, sentence, and discourse level measures across interventions.

3a.) RQ3a. What are the relative effects for each participant on word, sentence, and discourse level measures across interventions?

H3a Large effect sizes will be found on word, sentence, and discourse level measures for each intervention per participant

4.) RQ4. How does Script compare to VNeST intervention for improving language outcomes in individuals with chronic agrammatic Broca's aphasia?

H4a. VneST will be more efficient in improving language outcomes for the chronic agrammatic population.

Analysis of RQ1. When analyzing the standardized assessment data, a percentage of change score was obtained. To evaluate standardized assessment data, both participants increased on the subtest of the WAB-R scores including auditory comprehension, fluency, repetition, and naming. P1's aphasia quotient increased from 46.5 to 69.9. P2's aphasia quotient increased from 42.5 to 50.3. On the BNT, P1's scores increased from 31 to 44 and P2's score increased from 30 to 34. Additionally, both participants increased on the confrontation naming task of the BNT scores, and the executive functioning scores on the CLQT. P1 increased her NAVS scores from 45% to 57%. P2's pre- and post- NAVS score remained the same. On the NAVS, P2 had more difficulty with the verb production task and the argument structure task indicating that production of verbs was more difficult

for this participant. P1 was able to slightly increase her CIUS with the

procedural narrative tasks increasing from 4 to 5 words and her percentage of

CIUS increased from 10 to 11 on the picture description tasks. Furthermore,

P2 did not increase his CIUs production on picture sequencing tasks from

pre- to post- treatment. Both participants were able to increase their language

subtest scores on the CLQT language scores 15 to 22 and 11 to 20.   Please

see Table 5 for full assessment data scores.

Table. 5

Descriptive Statistics for Pre- and Post- Treatment Assessment Data.

	P1		P2	
	Pre	Post	Pre	Post
WAB-R	46.5	69.9	42.5	50.3
BNT	31	44	30	34
NAVS	45%	57%	38%	38%
CIUS	4,10,4	5,11,5	3,9,4	4,10,4
CLQT	15	22	11	20
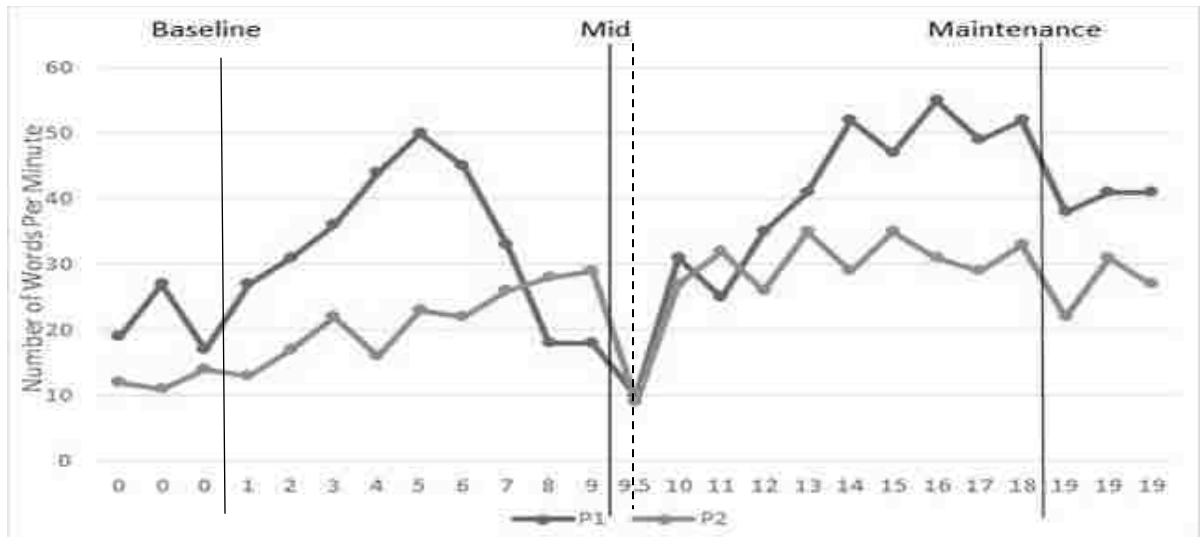
Figure 6. Rate of speech for P1 and P2 from baseline through maintenance phases.

P1 rate of speech increased from 19 to 40 (WPM; words per minute) from baseline to maintenance phases. P1 demonstrated an upward trend throughout the study, except during the washout period. She received Script therapy and then VNeST interventions. P2 received VNeST and then Script interventions. P2's rate of speech increased from 11 to 31 WPM from baseline to maintenance phases. Also, P2 exhibited a decrease in rate or WPM during the washout period as P1. Overall, P2's rate of speech did increase but not as significantly as P1's rate.
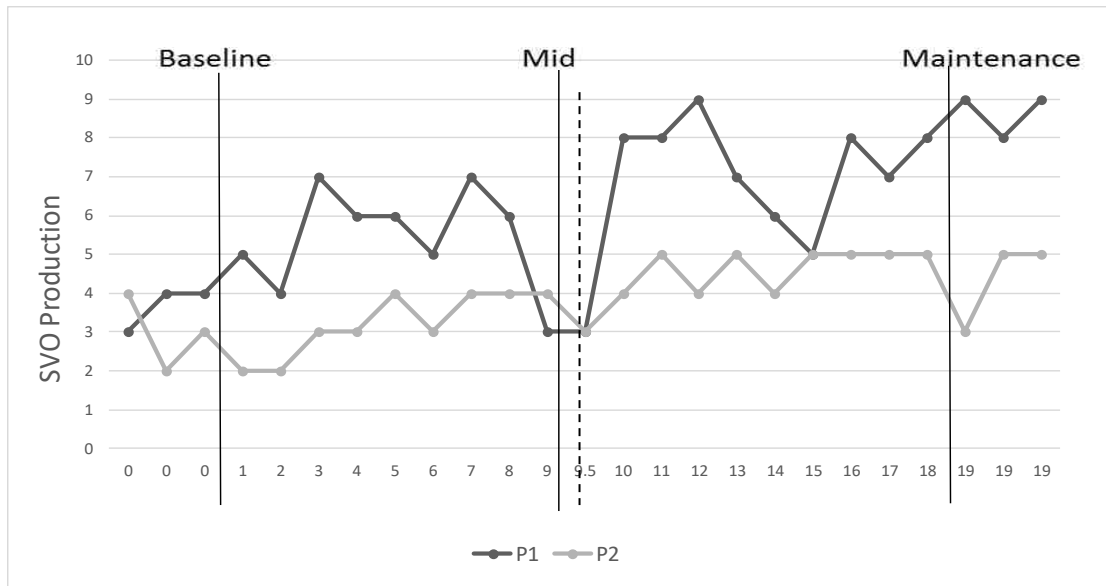
Figure 7. Sentence-Verb-Object (SVO) production per participant across
baseline to maintenance phases

Both participants increased SVO production from baseline to
maintenance phases. During the washout period, both participant exhibited
the same decline in SVO production as with rate of speech. P1's SVO
production increased from 3 to 9 SVO productions from baseline to
maintenance phases. P2's increased from 4 to 5 SVO productions from
baseline to maintenance phases. Similarly, P2's SVO production did increase
but not as much as P1's. Also, with the rate of speech measure, SVO
production also decreased with both participants during the no-intervention
phase.
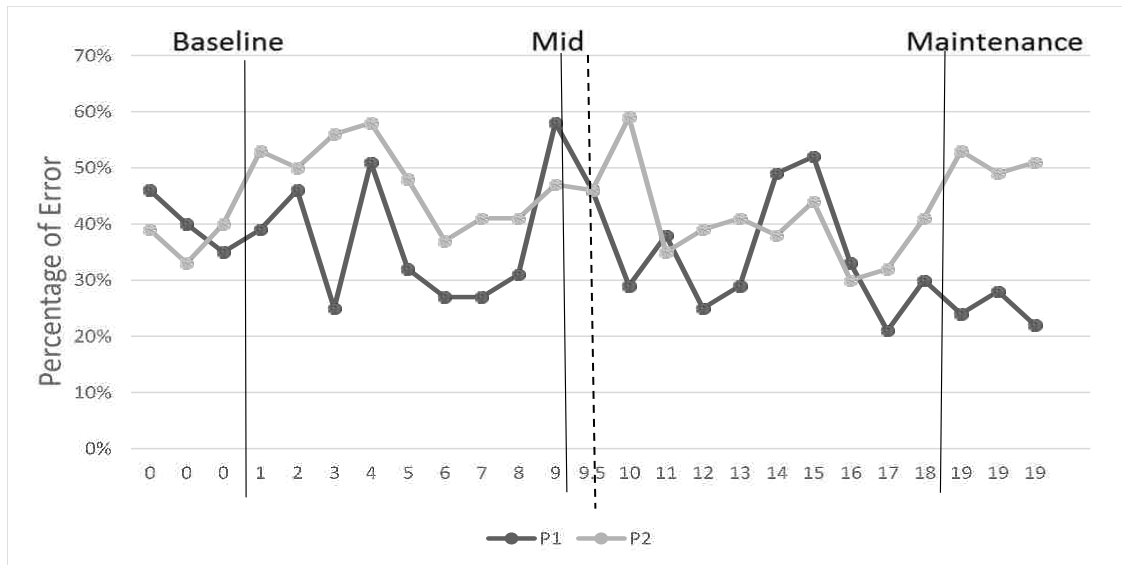
Figure 8. Percentage of error per participant from baseline to maintenance phases.

Error rates for both participants remained high throughout the study. P1's error rate decreased from 46% to 21% from baseline to maintenance. P2's error rate increased from 39% to 52% from baseline to maintenance. Both participants' error rates were the highest during the no intervention phase.

Analysis of RQ2. Given the order of treatments, both participants increased their word level measures or rate of speech, SVO or sentence level measures and P1's error rate or discourse level measure decreased from the baseline to maintenance phases. These results indicate that both interventions were effective for P1 and P2 at the word and sentence level. As for error rate, only P1's error rate decreased from pre-to-post treatment. For

P2, his error rate increased from baseline to maintenance phases. The

effectiveness of these treatments can be seen during the no intervention

phase where all outcomes either decreased or increased for these

participants. In summary, during the intervention phases both participants

benefitted from these treatments.

Analysis of RQ3. To evaluate RQ3. (magnitude of change from

baseline to maintenance), effect sizes *(d2*; Busk & Serlin, 1992), were

calculated to get to get an "index of durability" (Beeson & Robey, 2006,

p.167). A meta-analysis of aphasic treatment studies by Robey and Beeson

(2006) resulted in benchmarks of 4.0, 7.0, and 10.1 for small, medium, and

large effects so these numbers are used to aid interpretation of the results.

Table 6.

Effect sizes from baseline to maintenance phases

	P1	**P2**
Rate of Speech	40-21/3.93)= 4.83 **Small effect**	(26.67-12.33/3.36)=4.27 **Small effect**
SVO Production	(8.66-3.66/0.57)=8.77 **Medium to large effect**	(4.33-3/1.07)=1.24 Relatively no effect

Error Rate	(25-40/4.44)=3.37	(51-37/3.02)=4.63
	Relatively no effect	**Small effect**

Busk and Serlin

$$\underline{d2 = x-_{A2} - x-_{A1}}$$
$$s\text{pooled}$$

Figure 9. Busk & Serlin's (1992) Equation for calculations of effect sizes.

Beeson and Robey (2006) explained that Busk and Serlin's $d2$ (1992) effect size formula is beneficial in single subject designs such as this study. Busks and Serlins' (1992) formula states that $A2$ and $A1$ designates maintenance and pre-treatment periods, respectively, $\bar{x}_A$ is the mean of the data collected in a period, and s_{pooled} is the square root of the weighted average of the variances for $A1$ and $A2$.

According to the Beeson and Robey (2006) benchmarks, the effect sizes for rate of speech or word level measures were ($d2$ = 4.83; $d2$ = 4.27 WPM) indicating a small effect for WPM for both participants. For SVO production or sentence level measures, P1 yielded an effect size of ($d2$ = 8.75) indicating a medium to large effect. P1 increased her SVO combinations from 4 to 9 by the maintenance phase. P2's SVO production yielded little to no effect ($d2$ = 1.02). For error rates, the effect sizes were calculated using

absolute value since the two treatments were designed to decrease an undesirable behavior rather than increase a desirable behavior (Beeson & Robey, 2006).

On discourse level measures, P1's error rate yielded little to no effect ($d2$ = 3.37). This effect size for error rate was interesting in the fact that P1's error rate did decline from the baseline to maintenance phases. Furthermore, P2's error rate yielded a small effect ($d2$ = 4.63) indicating that error rates did increase by 5 errors per probe from baseline to maintenance phases.

Analysis of RQ3a. Using the Percentage of Data Points Exceeding the Median (PEM) scores, Ma (2006) created another way to evaluate data interventions. For intervention studies focusing on increasing behaviors, Ma (2006) suggested that reviewers draw a median line for the baseline data and calculate the percentage of data points in intervention that fall above the median line for behavior reduction studies, then percentage of data points below the median line should be calculated. Several strengths could be found in the PEM approach. First, there have been no reports of situations where PEM could not be used. Second, PEM has been shown to be correlated with author judgments of intervention effectiveness (Ma, 2006). The null hypothesis of the PEM approach is that if the treatment has no effect, the data points in the treatment phase will fluctuate up and down around the middle line. The data points have 50% of chance of being above and 50% chance of being below the median of previous baseline phase. The PEM

score has a range of 0 to 1. The PEM score has the same meaning as the effect size. One can compute one PEM score from each pair of baseline treatment phases. One can further calculate the overall mean effect size of each article or the mean effect size of each variable category.

Table 7.

Score Ranges for PEM interventions.

PEM Score Ranges	
.9 to 1	Highly Effective Treatment
.7 to .9	Moderately Effective Treatment
< .7	Questionable or Ineffective Treatment
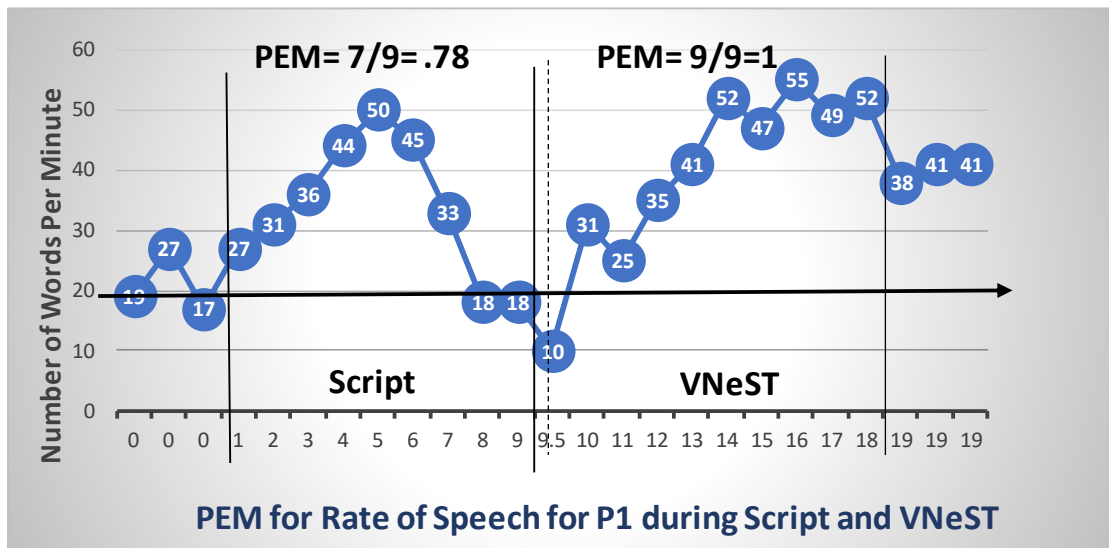
Figure 10. PEM data for P1 for Rate of Speech during Script and VNeST.

P1's PEM score for rate of speech yielded a score of 19 words per minute at baseline which means that Script Therapy (PEM score = .78) which indicates that Script was moderately effective. A PEM score of (1) on VNeST indicates that this therapy was highly effective for this participant.
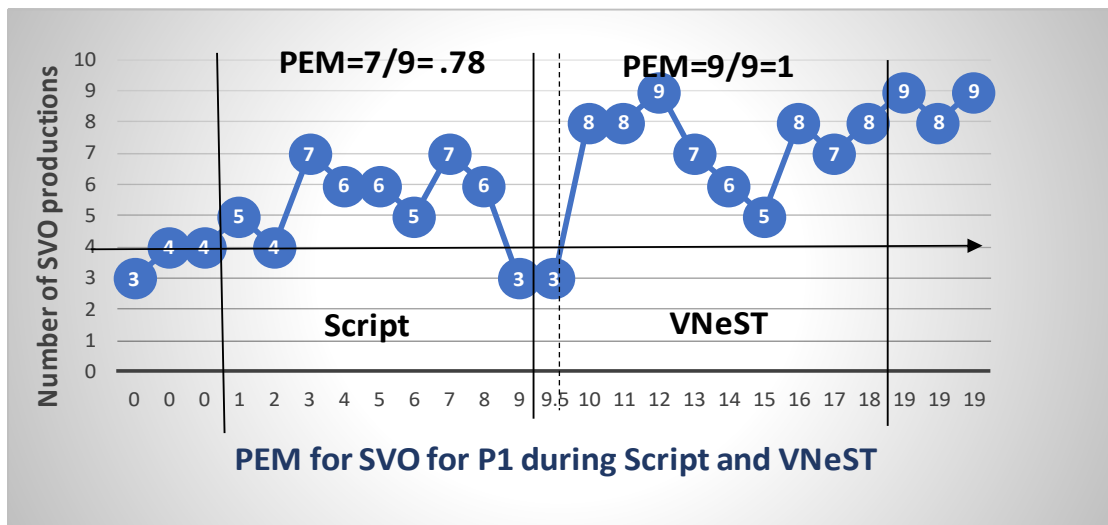
Figure 11. PEM data for P1 for SVO production during both Script and VNeST

For P1, Script therapy (PEM = .78) was moderately effective in the first nine weeks on the SVO outcome measure. Additionally, P1's score of (PEM = 1) during VNeST therapy means that this therapy was highly effective.
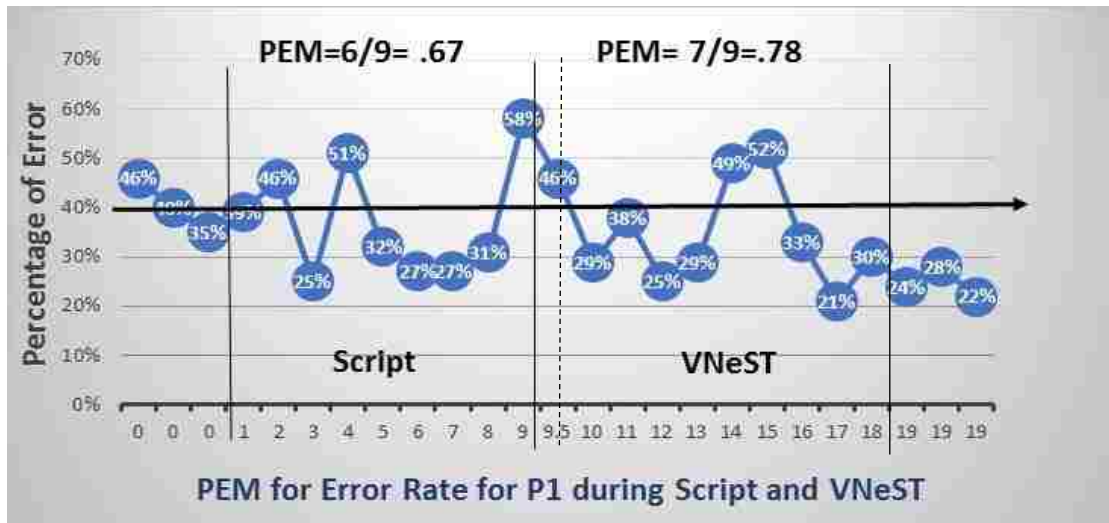
Figure 12. PEM data for P1 for Error Rate during both Script and VNeST

P1's PEM scores were (.67) for Script indicating a questionable effect
and (.78) VNeST interventions indicating moderately effective on the outcome
measure of error rate.
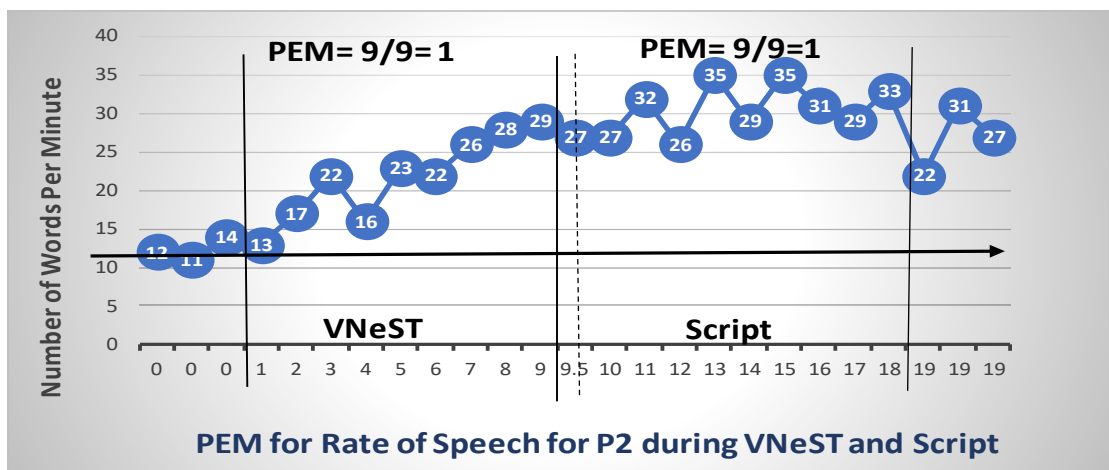
Figure 13. PEM data for P2 for rate of speech during VNeST and Script

For both VNeST and Script treatments, P2 exhibited PEM scores of (1 & 1) indicating that both treatments were highly effective on rate of speech.
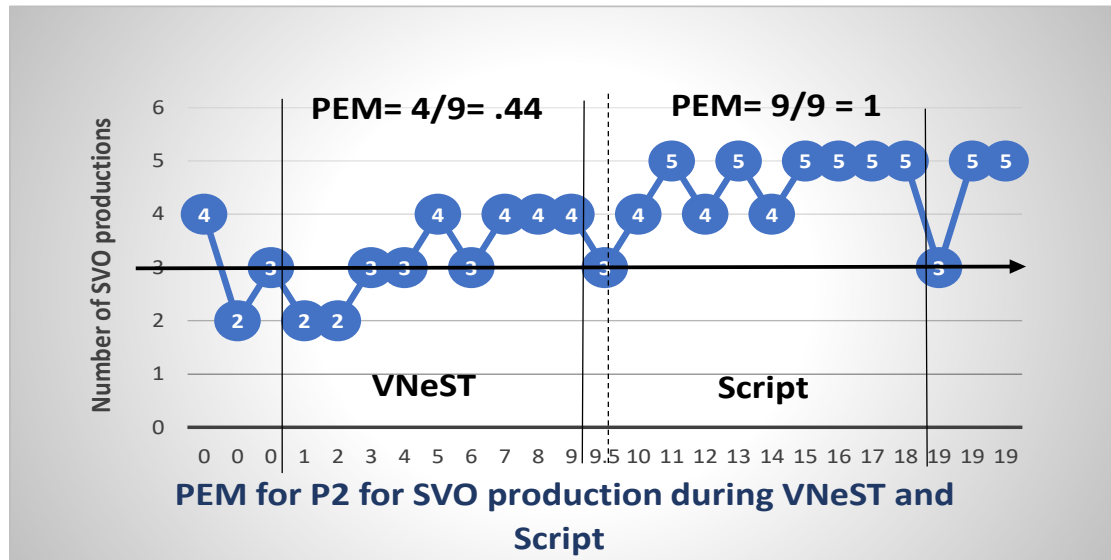
*Figure 14. P*EM data for P2 for SVO production during VNeST and Script

For VNeST, P2's PEM score was (.44) indicating that this treatment was ineffective. For Script therapy, P2's PEM score (1) indicated that Script therapy was highly effective.
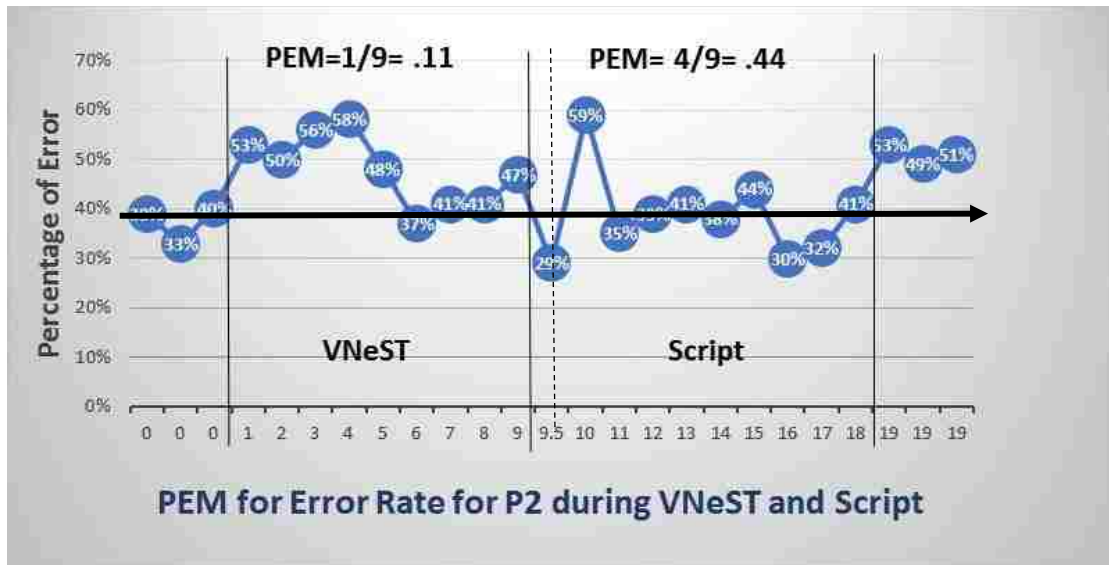
Figure 15. PEM data for P2 for Error Rate during VNeST and Script

P2's PEM score was (.11) on VNeST and (.44) on Scripts indicated that neither treatment was effective for error rate.

Table 8.

Summary Table for Effect Sizes and PEM Scores for P1

	P1		
	Script	**VNeST**	
	PEM	**PEM**	**Baseline to Maintenance Effects**
Rate of Speech	.78 Moderately effective	1 Highly effective	4.83 Small effect
SVO	.78 Moderately effective	1 Highly effective	8.77 Medium to large effect
Error rate	.67 Ineffective	.78 Moderate effect	3.37 No effect

Table 9.

Summary table for effect sizes and PEM scores for P2

	P2		
	VNeST	**Script**	
	PEM	**PEM**	**Baseline to Maintenance Effects**
Rate of Speech	1 Highly effective	1 Highly effective	4.27 Small effect
SVO	.44 Ineffective	1 Highly effective	1.24 No effect
Error rate	.11 Ineffective	.44 Ineffective	4.63 Small effect

Summary analysis (RQ4.) When analyzing the baseline to maintenance effects, and PEM scores, both participants demonstrated variability on outcome measures across interventions. P1 exhibited a small effect for Script therapy on the outcomes measures. For VNeST, P1 demonstrated a greater change for SVO production. After analyzing baseline to maintenance effects, P1 demonstrated small effects for rate of speech and medium to large effects or change for SVO. P1 produced more limited effects during both interventions. The PEM scores for VNest do prove this intervention was beneficial for P2. A small effect was noted for rate of speech during Script therapy. PEM scores did show that Script therapy was effective for rate of speech and SVO for P2 .For baseline to maintenance effects, a small effect was noted for rate of speech and error rates. P2's error rate did change but actually increased from baseline to maintenance probes.

Chapter V

DISCUSSION

The aim of this study was to assess whether one treatment: Script or VNeST was more beneficial for participants with agrammatic Broca's aphasia and to determine the effects on outcome measures at the word, sentence, and discourse levels. Also, to determine whether a combination of the social functional and impairment specific approaches are most effective for this population and to explore the use of a single subject multiple-baseline alternating treatment across participants' design.

Study Predictions

It was predicted that the participants would demonstrate an increase in rate of speech and SVO production through the study. Another prediction was that error rates would decrease over the course of both treatments.

Overall Results of Interventions

Both participants benefitted from the interventions in this study even though they were considerably post-incident at 20 and 26 months. The participants made considerable gains on the outcome variables.

Validity of standardized assessment measures

Pre- and post-treatment and descriptive data demonstrated that the participants were similar across demographic and assessment scores. The overall results showed different responses across participants with P1 exhibiting greater effects than P2. The results of the pre-and post-treatment measures were similar to previous studies have established that traditional linguistic or impairment specific approaches have an effect on impairment measures such as the WAB-R, NAVS, CLQT, CIUS and BNT (Edmonds et al., 2009, Edmonds & Babb, 2011, Beeson & Robey, 2006). Both participants with agrammatic Broca's aphasia benefitted from the two treatment approaches based on post-treatment assessment scores. Based on the post-treatment results, these assessments are useful for validating the interventions as well as providing quality linguistic and cognitive data for individuals with agrammatic Broca's aphasia. Furthermore, examining the effect sizes can help determine if the interventions were beneficial and PEM data can show the variability of both interventions per participant.

Effect Sizes

Baseline to Maintenance Effects

For rate of speech, P1 and P2 yielded small effect sizes (P1: d2 = 4.83; P2: d2 = 4.27) based on baseline to maintenance phases. For SVO production, P1 produced a medium to large effect (P1: d2 = 8.75). P2 demonstrated relatively no effect for SVO production with a small effect (P2:

d2= 1.02). For error rate, P1 produced relatively no effect of (P1: d2 = 3.37). P2 produced a smaller unfavorable effect for error rate (P2: d2 = 4.63).

After analyzing the effect size outcomes, it is important to note that the Beeson and Robey benchmarks (4.0,7.0, and 10.1) are set as framework for aphasia research. Additionally, these effect size values provide a means to compare treatment outcomes within and between individuals, as well as to compare the relative strength of various treatments for aphasic populations (Beeson & Robey, 2006).

In this study, the participants did demonstrate improvements, despite small effect sizes indicating that these therapies were useful in producing change for the agrammatic Broca's aphasia.

Percentage of Data Exceeding the Median (PEM)

In general, the effect sizes were not always consistent with the PEM results per participant. The PEM scores can help validate effective interventions and can contribute to the strength of the effect size scores (Ma, 2006). It is important to note that PEM evaluates a potential change or variation of scores across treatment and probe assessment sessions. P1's PEM score for rate of speech during Script was moderately effective. For VNeST, P1'S PEM score was highly effective. P2's PEM rate of speech score was very effective for both treatments. For P1, Script therapy PEM score was moderately effective in the first nine week SVO production. P1's VNeST PEM

score was very effective for SVO production. For P2, SVO PEM score was moderately effective for VNeST and highly effective for Script. For error rate, P1'S PEM score was ineffective with script and moderately effective for VNeST. P2's PEM score for error rate for both interventions were scored as ineffective.

Effectiveness of the Interventions by outcome measure

Based on the effect sizes and inter-therapeutic PEM scores, both interventions Script and VNeST were found effective in treating at the word and sentence levels for these participants with chronic agrammatic Broca's aphasia. VNeST was considered more effective for both participants for rate of speech based on PEM scores. Script was considered most effective for SVO productions based on inter-therapeutic PEM scores. Finally, neither intervention was considered effective for error rate. For P1, VNeST was more effective than Script during the therapeutic phase of study on all outcome measures. Script Therapy was more effective on rate of speech and SVO production during the therapeutic phase of the study for P2.

Given the participants status post stroke, perhaps they have to live with some errors in speech at the sacrifice of clearer communication. In the future, it may be possible to isolate the error patterns and provide an alternative type of therapy that would address specific errors per participant.

Effectiveness of the Interventions per participant

After summarizing the effect sizes, and PEM scores, it appears that both treatments were successful for P1 and P2 performance in individual ways. VNeST involves the activation of large semantic networks that can potentially result in generalization to lexical retrieval. (Edmonds et al., 2009). Theoretically, generalization to outcome measures should occur if other, more complex measures are also to improve. This appears to be the case for P1, she improved over the course of the 18 weeks with the outcome measures; however, her error rate decreased with no effect. For P1, she demonstrated generalization on the outcome measure of rate of speech across the course of the 18 weeks. Additionally, she increased on all pre-to-post treatment assessment measures. She presented with morphological errors, repetition errors, and articulation errors due to apraxia, but her word retrieval was better for semantic networking. P1 was rated as mildy apraxic so having phonemic errors are consistent her diagnosis of agrammatic Broca's aphasia and apraxia. Additionally, P1 did suffer seizures after the stroke with which she was currently being medicated and the impact of the medication Gabapentin may have impacted her performance during the study.

Although, P2 presented with more limited generalization on outcome measures, there were many indications for clinical improvements. First, he increased his pre-to-post treatment assessments scores except for the NAVs and CIUs. It is not completely clear as to why P2 did not improve to the extent

that P1 did throughout the study. Both participants did improve over the course of the study but P1's effect sizes from baseline to maintenance demonstrated a greater magnitude of change. First, it is possible that the time between P2's stroke and the start of the study could have attributed to the second participants level of performance. Secondly, P2 had slightly lower scores on the assessments than P1. P2 presented with slightly lower scores on the comprehension portions of the WAB-R, CLQT (Auditory Comprehension portion), and the NAVS (verb comprehension subtest). P2's processing and retrieval speed was also more reduced than P1. Furthermore, P2 presented with a dysarthric speech pattern that was different than P1. In P2's case history, he was diagnosed with depression after his stroke and was being treated with Zoloft an anti-depressant medication. Both participants had a similar cognitive profile for the CLQT. However, in-depth testing for cognition including working memory, attention, and other executive functioning abilities was not assessed during this study and could affect the response to treatment. P2 was more chronic in terms of word retrieval and types of errors. P2's wife said he was more willing to attempt SVO phrases at home with prompting than prior to the study. P2's errors included phonemic and semantic paraphasias, morphological errors, and perservations.

Despite differences in generalization across participants and interventions, both participants' post-treatment error patterns showed an evolution of responses that suggest differences in processing and lexical

retrieval during interventions. Across the tasks, P1 made more attempts at production and her post-treatment errors were more motor planning errors consistent with the apraxia diagnosis. For P2, presented more with lexical retrieval errors.

Other factors that can also contribute to the generalization across participants and the interventions include the intensity of the treatments, the impact of impairment specific and social functional approaches, communicative intent, differences in gender, and the order of interventions.

Intensity of therapy

In accordance with the pre-and post-treatment scores, the intensity of the therapies and the length of the study (two times per week for 18 weeks) could be another factor in the overall improvements on the treatment effects and outcome measures. Both Script and VNeST treatment protocols are based on nine weeks of treatment with two-one hour sessions per week (Cherney, 2010; Cherney et al., 2008; Cherney et al., 2011, Edmonds & Babb, 2011; Edmonds et al., 2014). This study's treatment was consistent with Robey's (1998) meta-analysis which demonstrated that the minimum intensity of aphasia therapy that affected change equaled two hours per week for chronic aphasics.

Impairment Specific vs. Social Functional

Given the fact that Script therapy is a social functional approach and that VNeST is an impairment specific approach, it is seemed counterintuitive that P1 and P2 exhibited such widespread gains. There are a number of factors that would predict potential improvements with this population. First, VNeST allows for the training of verbs, subjects, and objects which is the foundation needed for sentence production (Edmonds, et al., 2009; Edmonds & Babb, 2011). Second, VNeST is a semantic treatment that focuses on lexical, semantic, and phonological activation so theoretically during all phases of VNeST each area is activated (Edmonds et al., 2009). Nickels (2002) explained that individuals with impaired phonological, semantic, and lexical levels seem to benefit from tasks that combine semantic networking and activation. Additional areas such as the communicative intent, gender differences and the order of the interventions all can contribute to the effectiveness.

Communicative Intent

Unlike VNeST, Script Therapy focuses on retraining phrases of fluent automatic speech. This promotes personal functional sentence production for individuals with aphasia and apraxia of speech. Script therapy focuses on a social approach to communication. Additionally, the use of Scripts allowed these participants to tailor their intentions for communication. P1's intention

for communication involved being able to have a repertoire of phrases that she could use with her daughter's pre-school teacher. For P2, he wanted to be able to have a phone conversation with long-distance family members.

Gender Differences

Males have a higher significance of morbidity for aphasia than females (69.90% to females 42.97%) especially after stroke (Yao et al., 2015). Broca's aphasia was reported as the most common type of aphasia for both male and female (29.01% and 24.22%). For the participants in this study, it was conclusive that the male participant exhibited greater impairment in communication than the female participant which was consistent with previous research findings.

Order of Interventions

Based on the data for P2, this participant benefitted from receiving VNeST therapy first and then Script Therapy. For this participant, the VNeST treatment acted as a priming effect for this participant. A similar result was found in Edmonds and Babb (2012). P1 improved on all dependent variables from Script Therapy to VNeST therapy. It seems that P1 benefitted from both intensity of therapy and the Script treatment then VNeST. It was hypothesized that P1 had more predicted motor planning issues due to the apraxia than word retrieval deficits. For P2, it seemed that VNeST helped with the activation of the semantic, phonological, and lexical retrieval which helped

possibly with the activation of the executive function areas such as memory,

initiation, and recall (Fridrickson, Nettles, Davis, Morrow & Montgomery,

2006).

Effectiveness of study design

The use of the multiple baseline single subject alternating treatment

across participants' design offered the ability to look at the individual

variability with the outcome measures, error types, and account for individual

variances. It was predicted that single subject designs are less concerned

with trends and help to increase internal validity and generalizability to real

world clinical applications for specific populations like agrammatic Broca's

aphasia (Schwartz, 2010; Olswang, 1993; Beeson & Robey, 2006).

Additionally, effectiveness studies or treatment outcome research can

evaluate the effects of efficacious treatments across broader, more typical

populations and under broader, more typical clinical conditions (Olswang,

1993). These designs foster treatment outcome changes during or after the

treatment process and addresses a variety of questions including cost of

treatment, quality of care, and achievement of functional change in the client

(Olswang, 1993).

Clinical Implications

Clinical Feasibility

Based on the outcomes of this study, both treatments can potentially benefit the agrammatic Broca's aphasic population. Both treatments, Script and VNeST, can be easily administered by speech-language pathologists, they are cost effective and have a high treatment intensity that is necessary for chronic aphasics. Additionally, the use of an impairment specific treatment in combination with a social functional treatment can better target the agrammatic Broca's aphasics ability to access fluent and accurate language and can have tangible and psychosocial benefits.

Limitations

Although the present study has yielded some preliminary findings, there were some limitations. These limitations included possible treatment effects of the 18-week treatment. Treatment fatigue due to the longevity of the study. There were a limited number of participants recruited due to the type of aphasia and the length of the study. Statistical challenges included the small number of participants, the use of non-parametric statistics, and possible order effects on outcome measures. In the data analysis, there was limited ability to generalize results due to the small sample size and the convenience of the sample. Furthermore, the findings of the study can be generalized to the population of agrammatic Broca's aphasia. Nevertheless, aphasia is a multifaceted condition with each individual presenting with different symptoms and levels of severity.

Chapter VI

CONCLUSIONS

This chapter highlights the results of the current study and the conclusions drawn regarding the outcome measures and the treatment approaches. Moreover, the need for future research is outlined.

Conclusion

Severity of aphasia and individual participants' characteristics impact the relationship between intensity and improvement (Lee et al., 2009). P2 had a different intention to communicate than P1. People with aphasia choose to speak about their life experiences, choose to reconnect with their families, and tend to focus on communication that can help them to negotiate mundane normal life. Independent of how this content is used in treatment, materials should emphasize matters of high personal relevance to those treated (Holland, Halper & Cherney, 2010).

It is possible that the multi-modal nature of the training between VNeST and Script helps promote functional sentence production and a linguistic approach for sentence production contributed to a positive language change for both participants (Edmonds, Nadeau,& Kiran, 2009; Edmonds &

Babb, 2011, Edmonds, Mammino, & Ojeda, 2014; Cherney, Halper, Holland, & Cole, 2008).

P2 did exhibit difficultly initiating language more so than P1. It seemed beneficial for this participant to have a scripted inventory of phrases that he could use.

P2 had an easier time finding the correct words, but would often have difficulty and either perseverate or produce phonemic paraphasias. P1 presented with more anomic responses so she often said she didn't know or produced repetitious responses.

Future Directions

This study is a contribution to clinical practice in aphasia. Results such as those in the present study will hopefully advance the knowledge on treatment options and serve as a basis for applying an impairment specific treatment and social functional treatment for individuals with agrammatic Broca's aphasia. This study also demonstrated the benefits of using a multiple- baseline across participants design with this population from a cost and benefit perspective. Also, the two treatments in this study can help speech-language pathologists help deliver beneficial, cost effective, and feasible care to their patients.

Future areas of research could involve more participants, possibly implementing VNeST first for the first treatment and then alternating with

another social functional approach like Script or a Supported Conversation

Treatment.

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APPENDIX A

LASALLE UNIVERSITY IRB APPROVAL

<table>
<tr><td>

LASALLE UNIVERSITY

</td><td>

INSTITUTIONAL REVIEW BOARD
FWA #000023562
1900 W. Olney Avenue, Philadelphia, PA 19141
E-mail: IRB@lasalle.edu

</td></tr>
</table>

IRB NUMBER: 15-03-009-3.17-RC
(Reference this # on all future correspondence to the IRB)

Name of Investigator:	Maureen Costello-Yacono
Address of Investigator:	Department of Communication Sciences and Disorders
Protocol Title:	Comparison of Two Treatment Approaches for Agrammatic Aphasia

This is to certify that the above-referenced protocol, which does propose research activities involving human participants, was reviewed in accordance with La Salle University Institutional Review Board (IRB) guidelines for the protection for human participants.
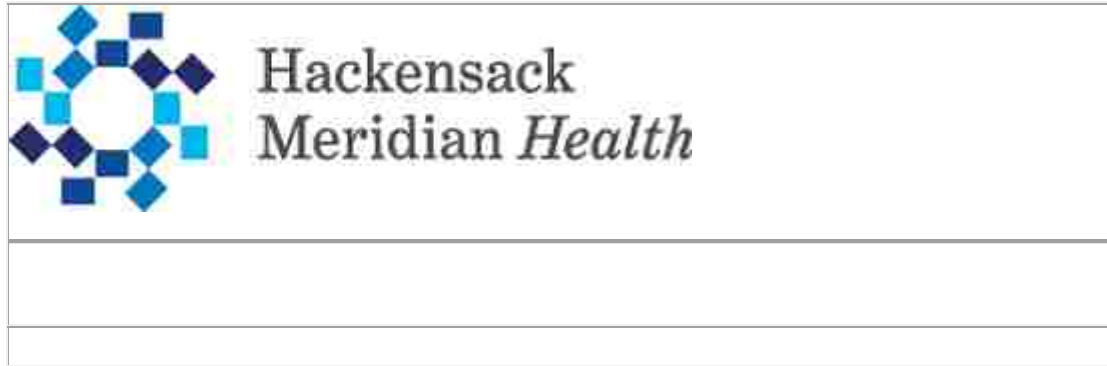
PROTOCOL INFORMATION:

Application Type:	Continuing Review (Re-approval of an Expiring Protocol)
Review Category:	Expedited review, under 45 CFR 46.110 Category 9
Protocol Action & Date:	Approved for Continuation on Mar 29, 2017
Protocol Expiration Date	Mar 27, 2018
Renewal Date*:	Jan 15, 2018

The IRB reviewed and approved your research protocol, *with the following provisions*:

1. **Update the consent and recruitment** documents to reflect the additional approval dates in the IRB approval statement and title it as follows (no spaces): **15-03-009-3.17-RC_ARCHIVE_Costello-Yacono.**

2. E-mail the updated version of the protocol to mcanulty@lasalle.edu and **include the archive title in the subject line.**

3. *The IRB must conduct continuing review of previously approved non-exempt research at least once per year. The IRB must reassess the totality of the project and ensure that all criteria for IRB approval of research continue to be met. Per Federal Regulations, the PI must receive IRB re-approval at least 30 days prior to the expiration date. To ensure that there is no interruption to your research project, submit the Continuing Review Application at least 2½ months before the expiration date.

4. Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB in writing using the Amendment Request Form. You must receive IRB approval prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the participants.

5. Investigators are required to report within 5 business days to the IRB any injuries or other unanticipated or adverse events or problems involving risks or harms to human research participants

IRB Action Letter Revised 3/8/17   p 1

APPENDIX B

HACKENSACK UNIVERSITY MEDICAL CENTER IRB APPROVAL

Hackensack Meridian *Health*

NOTIFICATION OF APPROVED EXPEDITED CONTINUING REVIEW

From:	Robert Krugman, MD
To:	Maureen Costello-Yacono
CC:	
Re:	Continuing Review # CR00003707 for Study#: Pro00006239 Study Title: 2017 Review for Pro00006239 - Comparison of Two Treatment Approaches for Agrammatic Aphasia Expiration Date: 4/26/2018

This is to advise you that the above referenced Study has been presented to the Institutional Review Board for Expedited Review.

Please be reminded that all modifications to approved projects must be reviewed and approved by the Institutional Review Board before they may be implemented. Any changes to this protocol must be submitted for IRB approval before initiated.

All Serious adverse events and unexpected adverse events must be reported to Institutional Review Board within seven days.

Please do not make any changes to the IRB approved consent without approval of the IRB. Only the IRB stamped approved consent should be used.

If your study meets the definition of a qualifying study that meets the FDAAA 801 definition of an "applicable clinical trial", you are responsible for ensuring that the trial has

been registered properly on the Clinical Trials.gov website prior to the enrollment of any subject.

"Applicable clinical trials" generally include controlled clinical investigations, other than phase 1 clinical investigations (with one or more arms) of FDA-regulated drugs, biological products, or devices, that meet one of the following conditions:

- The trial has one or more sites in the United States
- The trial is conducted under an FDA investigational new drug application or investigational device exemption
- The trial involves a drug, biologic, or device that is manufactured in the United States or its territories and is exported for research

For complete statutory definitions and more information on the meaning of "applicable clinical trial," see Elaboration of Definitions of Responsible Party and Applicable Clinical Trial (PDF).

It is necessary that you utilize the assigned protocol number in any and all communication submitted to the IRB office, i.e. amendments, audits, etc.

This renewal has been approved via expedited review on 4/27/2017.

APPENDIX C

INFORMED CONSENT

LASALLE UNIVERSITY
SCHOOL OF NURSING
AND HEALTH SCIENCES
Department of Communication
Sciences and Disorders

Informed Consent

Title of Investigation: Comparison of Two Treatments for Agrammatic Aphasia

Investigator(s)/ Project Director(s): Maureen Costello-Yacono MS, CCC/SLP Clinic Director of the LaSalle University Speech-Language-Hearing Community Clinics

Faculty Sponsor: N/A

Purpose:
The purpose of this research is to determine which of two treatments are more effective in improving production of sentences, rate of speech, and conversation in individuals with agrammatic aphasia.

Agrammatic aphasia can be characterized by difficulties in the ability to produce words and sentences.

You will be asked to participate in two different treatments including Script Therapy and Verb Network Strengthening Treatment for a total of 26 weeks.

Scripts therapy can provide you as the participant with a set list of sentences or phrases that can be used in social situations. The goal of Script therapy is to help guide and facilitate your conversations and actions involved in social situations. Verb Network Strengthening Treatment (VNeST) is a treatment that aims to improve the production of verbs, subjects, and objects.

Procedures: If you consent, then you will complete the pre-treatment testing to ensure that you can meet the inclusion criteria. Pre-treatment testing involves a series of test batteries that measure linguistic skills affected by aphasia (such as content, fluency, auditory comprehension, naming, repetition, reading, writing, attention, memory, visuospatial skills, basic word retrieval using pictures, and the names of objects and action verbs.

You will then begin treatment using either Script Therapy or Verb Network Strengthening Treatment. This phase will continue for 9 weeks with two 60-minute sessions each week. During this phase of the study, you will also be asked to practice at home for 30 minutes each day.

The following week, there will be one session of post-treatment testing.

There will then be a two week break with no treatment (and no meetings with the researcher).

Initial:

1900 West Olney Avenue
Philadelphia, Pennsylvania
19141-1199 USA
P 215.951.1982
F 215.951.5171
www.lasalle.edu

You will then begin treatment using either Script Therapy or Verb Network Strengthening Treatment. That is, if you completed Script Therapy during the previous phase, you will now complete Verb Network Strengthening Treatment. If you completed Verb Network Strengthening Treatment during the previous phase, you will now complete Script Therapy. This phase will continue for 9 weeks for two 60-minute sessions each week. During this phase of the study, you will also be asked to practice at home for 30 minutes each day.

Over the next four weeks, there will be one final testing session. The final testing session will last 60 minutes.

From beginning to end, your involvement in the study will span 26 weeks.

All phases of the study will be video/audiotaped and as a participant you will be asked to sign a copy of the LaSalle University Speech-Language-Hearing Community Clinic Audio and Video consent form prior to starting the study.

This research may result in the following discomforts:
Treatment fatigue may result from the length of treatment. You are free to terminate the study at any time if discomfort results.

Participation in this research may involve the following benefits:
We cannot promise you will receive any benefits from participating in this study. However, participating in this study could improve your ability to produce words and sentences.

Research Findings: A general summary of research will be available to you once the study is ended and data collection and analyses are completed. You can obtain this summary by contacting the researcher (Maureen Costello-Yacono, LaSalle University 1900 W. Olney Avenue, Philadelphia, PA 19141, Department of Communication Sciences and Disorders (St. Benilde Tower; 215-951-1888).

Participation in this research may involve the following risks: There is a possible risk of fatigue and you are free to take a break from the study when needed.

Confidentiality/Anonymity:

All sessions will be videotaped and audiotaped. To keep your identity confidential, all data obtained from this study (including your Informed Consent, the testing results, data

Initial:

from Script Therapy, data from Verb Network Strengthening Treatment, and video and audio recordings, will be tracked using an alphanumeric code, which will be kept separate from this Informed Consent document and other identifying information. All data will be in a locked file cabinet in a password-protected room at LaSalle University Speech-Hearing Clinic for a period of seven years and then will be destroyed. Video and audio recordings will be stored on a password protected USB memory keys and will be deleted from those USB memory drives and destroyed after the research study is completed. The results of the study may be published or presented at a conference but your name will never be used.

Termination of Research Study:

As a participant, you are free to choose whether or not to participate in this study. There will be no penalty or loss of benefits to which you are otherwise entitled if you choose not to participate. You will be provided with any significant new findings such as alternate treatments developed during the course of this study that may relate to or influence your willingness to continue participation. In the event you decide to discontinue your participation in the study, any relevant findings will be given verbally and in writing.

Costs:

You are the participant will not responsible for any costs associated with this study, however, there may be added costs associated with travel.

Participation in the Study:

As a thank you for your participation in this study, you will be given an Ipod Touch even if you withdraw prior to the study's completion.

If you have any questions or concerns regarding this research, please contact

Maureen Costello- Yacono (Primary Investigator)
St. Benilde Tower #2024
215-951-1888
costellom3@lasalle.edu

If you have any questions or concerns regarding your rights as a research participant, please contact:

Initial:

Diana Montague, PhD Chair, Institutional Review Board
Psychology Department La Salle University
1900 W. Olney Avenue
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(215) 951-1280
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Dorothy Hilpmann, BA, CIP
IRB Specialist
Research Integrity Office
Hackensack University Medical Center
40 Prospect Avenue
Suite 224
Hackensack, NJ 07601
(P) 551-996-2255

Consent Statement: I have read the above description of a research project, or the above description of the research was read to me by the investigator. Anything I did not understand was explained to me by Maureen Costello-Yacono. I understand that my participation is voluntary and that I may withdraw my participation at any time with no penalty. I agree to participate in this study.

Participant:
Signature: Date:

Investigator:
Signature: Date:

The Institutional Review Board of La Salle University has reviewed and re-approved this study (15-03-009-C5.16) on 04/21/2016

Initial:

APPENDIX D

LETTER OF SOLICITATION

LASALLE UNIVERSITY

SCHOOL OF NURSING
AND HEALTH SCIENCES
Department of Communication
Sciences and Disorders

Treatment Study for Aphasia

Be part of an important aphasia research study

- Do you or someone you know have aphasia? Aphasia is a disorder that results from damage to the parts of the brain that control language. Aphasia causes problems with any or all of the following: speaking, listening, reading, and writing.
- Do you want to improve your communication skills?

If you answered YES to these questions, you may be eligible to participate in an aphasia research study.

The purpose of this research study is to compare the effectiveness of two treatment approaches for individuals with aphasia. Benefits include comprehensive language evaluations and two treatment approaches. All participants will receive a free Ipod Touch. Free parking is available. No medications will be given.

Adults between the ages of 25 to 65 are eligible to participate.

This study is being conducted at LaSalle University Speech-Language-Hearing Community Clinic

Please call Maureen Costello (215)951-1888 for more information

The Institutional Review Board of La Salle University has reviewed and approved this study (IRB #15-03-009-C5.16) on April _21ˢᵗ__, 2016

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103

APPENDIX E

INTERVENTION TABLES

	P1	P2
Baseline outcome measure assessment	Randomized probe/outcome measures	Randomized probe/outcome measures
Week 1; Session1	Scripts Development	VNeST Stimuli Development
Week 1; Session 2	Script Development	VNeST Stimuli Development
Week 2; Session 1	Treatment of Scripts (60 minutes)	Treatment of Trained Verbs (60 minutes)
Week2: Session 2	Treatment of Scripts Probe/Outcome measure assessment	Treatment of Trained Verbs (60 minutes) Probe/Outcome measure assessment
Week 3; Session 1	Treatment of Scripts (60 minutes)	Treatment of Trained Verbs (60 minutes)
Week 3; Session 2	Treatment of Scripts (60 minutes) Probe/Outcome measure assessment	Treatment of Trained Verbs (60 minutes) Probe/Outcome measure assessment
Week 4; Session 1	Treatment of Scripts (60 minutes)	Treatment of Trained Verbs (60 minutes)
Week 4; Session 2	Treatment of Scripts (60 minutes) Probe/Outcome measure assessment	Treatment of Trained Verbs (60 minutes) Probe/Outcome measure assessment
Week 5; Session 1	Treatment of Scripts (60 minutes) P1	Treatment of Trained Verbs (60 minutes) P2
Week 5; Session 2	Treatment of Scripts (60 minutes) Probe/Outcome measure assessment	Treatment of Trained Verbs (60 minutes) Probe/Outcome measure assessment
Week 6: Session 1	Treatment of Scripts (60 minutes)	Treatment of Trained Verbs (60 minutes)
Week 6; Session 2	Treatment of Scripts (60 minutes) Probe/Outcome measure assessment	Treatment of Trained Verbs (60 minutes) Probe/Outcome measure assessment

Week 7; Session 1	Treatment of Scripts (60 minutes)	Treatment of Trained Verbs (60 minutes)
Week 7; Session 2	Treatment of Scripts (60 minutes) Probe/Outcome measure assessment	Treatment of Trained Verbs (60 minutes) Probe/Outcome measure assessment
Week 8; Session 1	Treatment of Scripts (60 minutes)	Treatment of Trained Verbs (60 minutes)
Week 8; Session 2	Treatment of Scripts (60 minutes) Probe/Outcome measure assessment	Treatment of Trained Verbs (60 minutes) Probe/Outcome measure assessment
Week 9; Session 1	Treatment of Scripts (60 minutes)	Treatment of Trained Verbs (60 minutes)
Week 9; Session 2	Treatment of Scripts (60 minutes) Probe/Outcome measure assessment	Treatment of Trained Verbs (60 minutes) Probe/Outcome measure assessment
Session 9.5	Cookie Theft Pictures to assess	Narrative story retell
Two week break between treatments	→	
	PARTICIPANTS SWITCHED THERAPY	PARTICIPANTS SWITCHED THERAPY
Week 10; Session 1	VNEST Stimuli Development	Script Development
Week 10; Session 2	VNEST Stimuli Development	Script Development
Week 11; Session 1	VNest Stimuli Development	Script Development
Week 11; Session 2;	Treatment of Trained Verbs (60 minutes) Probe/Outcome measure assessment	Treatment of Scripts (60 minutes) Probe/Outcome measure assessment
Week 12; Session 1	Treatment of Trained Verbs (60 minutes)	Treatment of Scripts (60 minutes)
Week 12; Session 2	Treatment of Trained Verbs (60 minutes) Probe/Outcome measure assessment	Treatment of Scripts (60 minutes) Probe/Outcome measure assessment

Week 13; Session 1	Treatment of Trained Verbs (60 minutes)	Treatment of Scripts (60 minutes)
Week 13; Session 2	Treatment of Trained Verbs (60 minutes) Probe/Outcome measure assessment	Treatment of Scripts (60 minutes) Probe/Outcome measure assessment
Week 14; Session 1	Treatment of Trained Verbs (60 minutes)	Treatment of Scripts (60 minutes)
Week 14; Session 2	Treatment of Trained Verbs (60 minutes) Probe/Outcome measure assessment	Treatment of Scripts (60 minutes) Probe/Outcome measure assessment
Week 15; Session 1	Treatment of Trained Verbs (60 minutes)	Treatment of Scripts (60 minutes)
Week 15; Session 2	Treatment of Trained Verbs (60 minutes) Probe/Outcome measure assessment	Treatment of Scripts (60 minutes) Probe/Outcome measure assessment
Week 16; Session 1	Treatment of Trained Verbs (60 minutes)	Treatment of Scripts (60 minutes)
Week 16; Session 2	Treatment of Trained Verbs (60 minutes) Probe/Outcome measure assessment	Treatment of Scripts (60 minutes) Probe/Outcome measure assessment
Week 17; Session 1	Treatment of Trained Verbs (60 minutes)	Treatment of Scripts (60 minutes)
Week 17; Session 2	Treatment of Trained Verbs (60 minutes) Probe/Outcome measure assessment	Treatment of Scripts (60 minutes) Probe/Outcome measure assessment
Week 18; Session 1	Treatment of Trained Verbs (60 minutes)	Treatment of Scripts (60 minutes)
Week 18; Session 2	Treatment of Trained Verbs (60 minutes) Probe/Outcome measure assessment	Treatment of Scripts (60 minutes) Probe/Outcome measure assessment

Post-Treatment Assessments	WAB-R, BNT, CLQT, CIUS, NAVS, ABA-2	WAB-R, BNT, CLQT, CIUS, NAVS, ABA-2
Maintenance Phase: 4 weeks after study completion	Probes/outcome measures	Probes/outcome measures

APPENDIX F

SCRIPT TRAINING PROTOCOL

Minutes	Plan
1-15 minutes	**Open period of conversation –Review of today's goals**
15-25 minutes	**Practice 1 Script**
25-35	**Practice 2ⁿᵈ Script**
35-45	**Practice 3ʳᵈ Script**
45-60	**Review goals for session and homework practice**

- **For Script therapy, a review of the Script will be acquired and then the outcome measures of sentence production ,fluency of discourse and, rate of speech will be obtain at every session**

Mastery of 3 Scripts:

1.) Hobbies

2.) Vacation

3.)Phone call

Treatment structure for Script Therapy. Each participant will be seen individually for

two 60 minutes sessions for 9 weeks. Treatment sessions will be structured to allow at

least 3 10-minutes episodes of practicing Scripts, interspersed with approximately 4

brief periods of relaxed open conversation. At the beginning of each session, the

participants will be audio and video recorded while practicing the Scripts or the

targeted verb sentences. The participants will be recorded during this data collection.

As Scripts became mastered and entered a random practice phase, treatment sessions

will end with approximately 10 minutes of Script conversation practice to promote

flexible use of Scripts. The home practice sessions will be prescribed twice daily for

15 minutes each during which the participants practiced their Scripts via a tape recorder.

APPENDIX G

VNeST Treatment Protocol

Basic Daily Treatment Structure for VNeST (60 minutes)

Minutes	Plan
1-15 minutes	**Open period of conversation –Review of todays goals**
15-25 minutes	**Practice 8 trained verbs**
25-35	**Practice 8 trained verbs**
35-45	**Practice 8 trained verbs**
45-60	**Review goals for session and homework practice**

VNeST Stimuli Development. Stimuli will consist of 10 cards containing the names of 10 target verbs, six to eight cards for each verb containing three to four agents and three to four patients that formed three to four pairs related to each verb. Additionally, five cards containing the words who, what, where, when, and why and 12 sentences for semantic judgment and 12 sentences containing the target verb broken into four categories:

A. correct ("The designer measures the room."),

B. inappropriate agent ("The infant measures the lumber.),

C. inappropriate patient ("The chef measures the television"),

D. thematic reversal ("The room measures the designer") (Edmonds & Babb, 2011).

VNeST will be administered two times per week for two one hour sessions for a total of 9 weeks. During treatment, all participants will be asked to produce orally three to four thematic pairs (e.g. carpenter and lumber) for a provided verb (e.g. measure).When the participants are unable to produce a word, written options on cards will be provided. In this protocol, the participants will generate three to four agent pairs, then the participants will read each agent-patient pair aloud(the verb was not read aloud)and then chose one answer to a wh-question. Probes will presented during the beginning of each session (written or spoken). During treatment, participants will be asked to produce orally three to four thematic role pairs (e.g.,carpenter and lumber) for a provided verb (e.g.,measure). When they were unable to produce a word, written options on cards will be provided (some appropriate and some foils). Participants are encouraged to provide at least one personal pair (e.g., dad/boat for drive), and responses could change from week to week. In the original protocol (i.e., Edmonds et al., 2009), after generating three to four appropriate agent-patient pairs, participants read each agent-patient pair aloud (the verb was not read aloud) and chose one to answer wh-questions about it (e.g.,when, where,or why). Following the protocol, when the participants are unable to produce thematic role pairs for a provided verb; they are allowed to write their responses. Criterion for ending treatment is met when participants produced a minimum of 24 relevant agent-patient pairs (80% accuracy) during treatment Step 1 (e.g., for measure, acceptable pairs could include chef/sugar, wife/windows, or designer/room).

Treatment session structure for VNeST. Probe and control measures will be administered at the beginning of each session. During administration, probe pictures will be presented pseudorandomly with semantically related verbs (e.g.,bake/fry) in nonsequential order. For each picture, participants will be instructed to make a sentence and include him/her, the action, and this (while pointing to the agent [carpenter], verb [measure], and patient [stairs]). Prompts will not be not provided unless the participant produced a general word for the target (e.g.,cut instead of slice or man instead of carpenter), for which a prompt for a more specific word was given. Weekly probes will be administered in spoken and written modalities (on different days) to assess potential improvement in both modalities. For the control task, participants will be asked to complete sentences using a synonym for the provided adjective (e.g., Someone who is sick is also said to be _____[target =ll).In the event of multiple attempts, the adjective closest to the target will be scored.

ERROR ANALYSIS

SALT Error rate per session for P1: Probes

Session	Persevera	IDK	Paraphasi	Incomplet	repetition	interjectic	morpholo	omissions	substitutic
1	2	6	3	2	1	3	3	1	0
2	3	4	6	5	2	2	5	0	1
3	2	4	4	1	2	2	3	0	0
4	5	3	9	7	9	4	5	2	1
5	3	3	4	1	9	2	10	0	0
6	3	1	1	2	5	1	8	2	1
7	2	2	4	1	1	3	2	2	0
8	0	0	3	1	2	2	2	0	1
9	3	2	6	1	1	0	2	4	2
10	2	3	3	2	4	0	0	4	0
11	3	1	3	1	1	3	4	2	1
12	1	2	4	1	1	2	2	3	1
13	4	0	3	4	2	4	4	2	1
14	14	2	8	9	2	3	11	0	2
15	11	6	10	11	2	6	2	0	1
16	5	3	6	0	2	6	5	3	3
17	0	0	5	4	2	3	3	2	1
18	14	0	3	1	1	0	11	1	0

SALT Error rate per session for P2: Probes

Session	Persevera	IDK	Paraphasi	Incomplet	repetition	interjectic	morpholo	omissions	substitutic
1	3	0	6	1	4	0	0	0	0
2	4	0	5	2	3	0	3	0	0
3	5	0	6	4	2	0	7	0	0
4	5	0	4	0	2	0	5	0	2
5	4	0	7	3	2	0	6	0	0
6	5	0	6	0	1	0	5	0	0
7	6	0	5	1	2	0	4	3	0
8	7	0	4	0	3	0	6	1	2
9	6	0	12	0	0	0	5	2	2
10	4	0	8	5	2	0	11	2	0
11	3	0	9	4	0	0	4	0	2
12	4	0	6	2	0	0	4	0	4
13	6	0	5	4	3	0	7	3	0
14	6	0	4	4	0	1	6	0	1
15	8	0	4	2	3	0	7	0	7
16	4	0	5	3	2	0	4	0	1
17	3	0	4	2	0	0	3	0	1
18	7	0	8	2	0	0	8	0	3

SAMPLE SCRIPT

Hobby Script #1

C: What are some of your hobbies?

P: I watch crime shows on TV.

P: investigation

C: What are these shows about?

P: The show is about a detective investigating a crime

C: What channel are these shows on?

P: We have cable

C: great

P: I like it because I take criminal justice classes

C: Oh, ok you took criminal justice classes in college

P: yes, I studied criminal justice

C: cool

P: I like these shows because you find out what the criminal did

C: What was your favorite class in college?

P: I liked the forensic courses.