EFFICACY OF USING MUSIC THERAPY COMBINED WITH TRADITIONAL APHASIA AND APRAXIA OF SPEECH TREATMENTS

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LIST OF ABBREVIATIONS

AOS...Apraxia of Speech
CH ....Cueing Hierarchy
PROMPT...........................Prompts for Restructuring Oral and Muscular Phonetic Targets
MIT .... Melodic Intonation Therapy
BDAE-3 .... Boston Diagnostic Aphasia Examination-Third Edition
ASHA FACS...
American Speech-Language-Hearing Association Functional Assessment of Communication Skills for Adults
BNT.. Boston Naming Test
TRAD............................... Traditional Speech-Language Therapy Without Music Therapy
TRAD+M.............................. Traditional Speech-Language Therapy With Music Therapy

ABSTRACT

The literature suggests that music therapy is effective in the treatment of aphasia and apraxia of speech (AOS) (Beathard & Krout, 2008; Robey, 1998). To date, no studies have been conducted to determine if traditional speech-language therapy combined with music therapy leads to a more successful treatment outcome than traditional approaches alone. The purpose of this study was to determine the efficacy of utilizing music therapy in addition to traditional speech-language treatment in persons with chronic, stroke-induced aphasia and concomitant AOS. Using alternating treatment, single-subject design, two persons with acquired aphasia and AOS following a single stroke participated in weekly speech-language therapy three times a week for nine weeks to target expressive speech and language. Traditional treatment approaches included Cueing Hierarchy to improve overt naming of selected targets and the Eight-Step Task Continuum to improve speech sound production. The music therapy protocol followed the protocol established by Kim and Tomaino (2008), and included singing, breathing, oral-motor, and intonation exercises. The data collected included rate of acquisition of targets during each treatment block and retention of targets at three- and six-weeks following the end of each treatment block. These data suggest that both participants demonstrated improved speech production and oral naming skills following both treatment approaches. Further, both participants demonstrated improvements on standardized assessments. These data further suggest that not only do both participants demonstrate the greatest treatment effects following the traditional treatment combined with music therapy but also that these treatment effects continued after the music therapy component was removed from treatment.

CHAPTER 1

INTRODUCTION

Acquired neurogenic communication disorders occur when there is damage to the regions of the brain responsible for speech and language processing. The type and severity of an acquired neurogenic communication disorder depends upon the location and extent of the resulting brain damage. Communication disorders commonly resulting from left hemisphere brain damage are aphasia, a language impairment, and apraxia of speech (AOS), a motor-speech disorder.

Aphasia and Apraxia of Speech

As defined by Darley (1982), aphasia is an acquired communication disorder caused by brain damage, characterized by an impairment of language, including expressive production of language, comprehension of language, reading, and writing. It is not the result of sensory or motor impairments. The severity and characteristics of this impairment vary considerably depending on the location and extent of brain injury. Aphasia is common following stroke (Bersano, Burgio, Gattinoni, & Candelise, 2009; Pederson, Jorgensen, Nakayama, Raaschou, & Olsen, 1995; Scarpa, Colombo, Sorgato, & DeRenzi, 1987),and Damasio (2008) states that recent studies utilizing neuroimaging techniques reveal a neural network for language processing that extends well beyond the classically discussed Broca's and Wernicke's areas. Language processing involves cortical regions such as the temporal and prefrontal regions of the left hemisphere beyond Broca's and Wernicke's areas (Damasio, 1990; Damasio, Damasio, Tranel, & Brandt, 1990; Damasio & Tranel, 1993; Goodglass, Wingfield, Hyde, & Theurkauf, 1986). Subcortical structures including the left basal ganglia and thalamus have also been implicated (Damasio, Damasio, Rizzo, Varney, & Gersh, 1982; Graff-Radford, Damasio, Yamada, Eslinger, & Damasio, 1985; Graff-Radford, Schelper, Ilinsky, & Damasio, 1985; Naeser et al., 1982). As discussed by Chapey and Hallowell (2008), aphasia can be categorized into two major classifications: fluent and nonfluent. A person with fluent aphasia typically demonstrates speech production that is fluid, continuous, and free of inappropriate pauses or periods of silence. The fluent types of aphasia include Wernicke's, conduction, and transcortical sensory. Conversely, nonfluent aphasia is characterized by slower rate of speech, frequent pauses, and lack of meaningful content. The nonfluent aphasias include Broca's, global, and transcortical motor. Another form of aphasia that is not typically place in one of these two main groups is anomic aphasia. Anomic aphasia is characterized by intact language expression, comprehension, and repetition, but impaired word retrieval and overt naming.

Apraxia of speech is a motor speech disorder that disrupts the planning, programming, and sequencing of voluntary movements associated with the speech musculature (Darley, Aronson, & Brown, 1975). Darley and colleagues (1975) go on to describe the manifestations of AOS, which include articulatory errors, prosodic alterations, and inefficient oral posturing. Duffy (2005) indicates the parietal and frontal lobes of the left hemisphere are most often correlated with motor speech programming, and thus AOS occurs when damaged. More specifically, he names the left prefrontal and premotor cortices, including Broca's area and the supplementary motor area. The insula may also serve an important role speech planning and programming, as revealed by Dronkers (1996).

Considering this structure-function overlap between lesions associated with aphasia and AOS, it is reasonable to conclude that these acquired communication disorders would coexist. Although specific values were not reported, Duffy (2005) indicated that AOS is identified as the secondary diagnosis in many persons with a primary diagnosis of aphasia.

Traditional Treatments of Aphasia and Apraxia of Speech

Chomsky (1972) describes language as the “human essence,” and Chapey and Hallowell (2008) use this as a primary motivation of aphasia treatment. As Chapey (1994) explains, treatment can improve a person’s ability to communicate, thus reviving the human essence. As Brookshire (2007) discussed at length, there are several approaches to aphasia treatment; they include direct treatment of impaired linguistic processes and social-functional approaches to compensate for lost language function. Further, the approaches used to treat aphasia vary depending on the presence and severity of specific language impairments. Cueing Hierarchy (CH; Linebaugh, & Lehner, 1977; Linebaugh, Shisler & Lehner, 2005) is one treatment approach commonly used to improve word retrieval and overt naming abilities in persons with aphasia. Cueing hierarchy involves multiple and progressive supportive cueing ranging from no cue to repetition of the target. Successive levels of stronger cues are presented until the participant is able to produce the target. Once the appropriate response had been elicited, the order of stimulus presentation is reversed until the client is unable to name the target. At this time, stronger cues are again provided, and upon successful naming, the presentation of cues is again reversed. This pattern of increasing and decreasing cues is continued until the target is independently named when the stimulus picture is presented.

It has been documented in the literature that CH has the potential to improve naming performance in persons with aphasia (Fridriksson, Holland, Beeson, & Morrow, 2005; Linebaugh, et al., 2005; Wambaugh et al., 2001). Linebaugh and colleagues (2005) used a ten-step cueing hierarchy to treat overt naming of a close-set of targets in five participants with aphasia. The level of cueing required across treatment sessions was documented for high and low frequency targets trained and generalization targets not trained. The authors reported that four of the five participants demonstrated positive treatment outcome for high and low frequency trained targets as well as generalization targets. They go on to say that, in general, the participants showed greater treatment outcome for low versus high frequency targets. The authors suggest that the success of this treatment is associated with improvements in word retrieval in general, rather than improvement of specific treatment targets.

As previously discussed, aphasia and AOS commonly coexist; therefore, they are often co-treated by speech-language pathologists. One method used to treat AOS is Prompts for Restructuring Oral and Muscular Phonetic Targets (PROMPT; Chumpelik (Hayden), 1984). Here, tactile-kinesthetic cues are used to increase sensory feedback associated with each articulatory movement, thus improving the accuracy of the movements. For example, the clinician provides a cue to prompt specific oral movements associated with the production of each phoneme in a target. During PROMPT training, a clinician instructs the client to repeat a target phoneme, word, or phrase. If the client us unable to produce the target accurately, tactile-kinesthetic cues are provided to emphasize the sequence of muscle contractions associated with the target. The success of PROMPT to treat acquired AOS has been documented extensively in the literature (Bose & Square, 2001; Bose, Square, Schlosser, & van Lieshout, 2001; Freed, Marshall, & Frazier, 1997; Square, Chumpelik, & Adams, 1985; Square, Chumpelik, Morningstar, & Adams, 1986). Bose, Square, Schlosser, and van Lieshout, (2001) utilized the PROMPT approach to improve accuracy and automaticity of speech movements in an adult with acquire aphasia and AOS. Treatment targets included imperative, declarative, and interrogative linguistic forms. Accuracy of targets and generalization to untrained items were measured. The data revealed positive treatment outcome as determined by improved production of trained and untrained imperative and declarative forms; however, there was no improvement in the production of interrogatives following treatment. These data support the use of PROMPT to improve speech production in persons with acquired AOS.

Music Therapy for Aphasia and Apraxia of Speech

It has been suggested that an unimpaired right cerebral hemisphere is dominant for music in right-handed people (Jackson, 1931; Sparks, Helm & Albert, 1974), which might explain why some persons with aphasia can sing familiar songs despite an expressive language disorder. This phenomenon serves as the foundation of Melodic Intonation Therapy (MIT; Albert, Sparks, Helm, 1973). Used by music therapists and speech pathologists alike, MIT uses singing to recruit right hemisphere brain activity to facilitate speech production (Carroll, 1996). There are four levels of hierarchy of MIT and they are highly structured for a gradual progression of difficulty. Initially, the client and clinician simultaneously produce a melody while tapping out the rhythm, later saying a sentence to the melody. As the client becomes more proficient performing these tasks, the clinician reduces her involvement allowing the client to produce utterances independently. To increase the level difficulty, the delay between the presentation of the stimulus and production of the client's response is extended. Later, the client is instructed to respond to a stimulus question to facilitate spontaneous production of treatment targets. In the final level, the client is trained to produce the previously sung targets with more typical stress and intonation. Hand-tapping is filtered out in this level, and pauses are lengthened between stimulus presentation and client response. As in earlier stages, questions to elicit a spontaneous response of the trained target are presented (Sparks, 2008).

Several studies have investigated the efficacy of music therapy when coupled with traditional aphasia or apraxia of speech therapies or independent of other treatment approaches (Belin et al., 1996; Dworkin, Abkarian & Johns, 1988; Kennelly, Hamilton & Cross, 2001; Hundley & Drew, 2007). Hundley and Drew (2007) investigated the efficacy of MIT to improve the production of trained targets as well as generalization to untrained items in two participants with chronic Broca's aphasia and AOS. Three MIT hierarchy levels, with 20 stimulus items for each level, were trained two to three times per week for one hour. Results of the study showed that both participants reduced characteristics of AOS characterized by improved onset of speech, more appropriate prosody, and a reduction in articulation errors. Further, both participants showed generalization to untreated items.

In another study, Kennelly, Hamilton and Cross (2001) discussed the conjoint use of music and speech therapies to treat acquired neurological speech and language disorders. The data suggest that the benefits of music therapy go beyond the previously discussed benefit of improved speech production. Both participants in this study demonstrated improved attention to treatment tasks when speech exercises were paired with music. Participants also attempted to verbalize more often and demonstrated improved auditory comprehension when following directions.

Following the documented success of MIT and the abundance of literature supporting the use of traditional therapy approaches with music therapy, Kim and Tomaino (2008) sought to establish guidelines for the use of music therapy with persons with nonfluent aphasia. In this study, seven adults between the ages of 50 and 70 with non-fluent aphasia were trained using a protocol similar to MIT. Each participant received 8 to 12 individual music therapy sessions, each lasting for 30 minutes approximately 3 times a week for 4 weeks. Kim and Tomaino (2008) listed the following seven techniques utilized in this program: singing familiar songs, breathing into single-syllable sounds, musically assisted speech, dynamically cued singing, rhythmic cued speech, oral-motor exercises, and variations in intonation. Although the purpose of this paper was to present a music protocol and to document general effectiveness of the techniques used, the results were promising, suggesting that all participants benefited from this therapy approach. In all, the authors suggested that this music therapy protocol was effective in increasing speech production for all participants with nonfluent aphasia. In addition, they suggest that focusing on temporal and rhythmic processing was an important component for patients with nonfluent aphasia, and facilitated a positive treatment outcome.

Statement of Purpose

To the author's knowledge, there have been no studies to date investigating the efficacy of using traditional aphasia and AOS treatments combined with music therapy.

The purpose of this study was to determine the efficacy of utilizing music therapy in addition to traditional speech-language treatment in persons with chronic, stroke-induced aphasia and concomitant AOS. The following questions were addressed and hypotheses tested:

Question 1: Will persons with aphasia and concomitant AOS demonstrate improved speech-language abilities following a traditional speech-language treatment combined with music therapy?

Hypotheses

H_0: Persons with aphasia and concomitant AOS will not demonstrate improved speech-language abilities following a traditional speech-language treatment combined with music therapy.

H_1: Persons with aphasia and concomitant AOS will demonstrate improved speech-language abilities following a traditional speech-language treatment combined with music therapy.

Question 2: Will traditional speech-language treatment combined with music therapy lead to better treatment outcome when compared to traditional speech-language treatment alone?

Hypotheses

H_0: Traditional speech-language treatment combined with music therapy will not lead to better treatment outcome when compared to traditional speech-language treatment alone.

H_1: Traditional speech-language treatment combined with music therapy will lead to better treatment outcome when compared to traditional speech-language treatment alone.

CHAPTER 2

METHOD

Participants

Two persons with a history of single-event stroke and confirmed aphasia with AOS as documented by comprehensive speech-language assessment were recruited for study participation from the Western Carolina University Speech and Hearing Center. Both participants were native speakers of English, ages 36 and 44, with no history of neurological dysfunction (e.g., dementia, traumatic brain injury, Parkinson's disease) beyond the effects of stroke. Both participants demonstrated hearing and vision sufficient for completion of experimental tasks prior to enrolling in the study. One of the participants (i.e., W.J.) had a vision impairment adequately corrected with the use of glasses.

Both participants read and signed the Informed Consent Form as approved by the Institutional Review Board of Western Carolina University. Prior to completing selected assessments, both participants were asked to provide personal, medical, and educational information. When necessary, this information was obtained from family members with the consent of the participant. Participants were then administered a battery of speech, language, and functional communication assessments, including the Boston Diagnostic Aphasia Examination-3rd Edition (BDAE-3; Goodglass, Kaplan, & Barresi, 2000) and the American Speech-Language-Hearing Association Functional Assessment of Communication Skills for Adults (ASHA FACS; Frattali, Holland, Thompson, Wohl, & Ferketic, 2003).

The BDAE-3 is an assessment of language function in aphasia, and includes measures of spontaneous speech, auditory comprehension, oral expression, reading, writing, and a separate assessment of oral, limb, and speech apraxia. The BDAE-3 includes five subtests to create a comprehensive speech and language profile. First, conversational speech and language production are assessed using a variety of simple personal and social questions, conversation, and picture description (i.e., “The Cookie Theft”). Auditory comprehension is then examined through tasks of single word comprehension, following of single and multi-step commands, and yes-no questions presented individually and in response to a paragraph read aloud by the examiner. The oral expression subtest examines several aspects of speech-language production, including non-linguistic and linguistic oral movements, the production of automatic speech (e.g., alphabet, numbers), melody and rhythm, repetition of words and sentences, and oral naming in response to questions and black-and-white pictures, as well as letters, numbers, and colors. Oral reading and reading comprehension at all levels of difficulty are assessed, as well as writing at all levels. These include single letters, numbers, words, and sentences of varying length and complexity. The mechanics of writing, such as handwriting, are also measured. Although included as one component of the oral expression subtest, the Boston Naming Test (BNT; Goodglass, Kaplan, & Barresi, 2000) is a commonly used task to assess overt naming of 60 black-and-white pictures representing targets of high to low frequency. This allows the examiner to explore the benefit of semantic and phonemic cues on object naming.

In addition to the BDAE-3, the ASHA FACS was utilized to evaluate participants’ functional communication skills before the initiation of treatment, after the

TRAD+M treatment block and after the final treatment session. This measure was completed by each participant's primary caregiver. The ASHA FACS measures the effects of speech, language, and cognitive communication disorders on functional communication. The ASHA FACS was found to be a reliable, valid, and sensitive measure with two populations: adults with aphasia resulting from left hemisphere stroke and adults with cognitive communication disorders resulting from traumatic brain injury (De Carvalho & Mansur, 2008). Presented as a survey, it evaluates the caregivers' perceptions of how functional communication attempts are in terms of social communication, communicating basic needs, reading, writing and number concepts, and daily planning.

Case Studies

Participant 1: Participant 1 (F.V.) was a 36-year-old Caucasian female who experienced a hemorrhagic stroke in October of 2008. She was diagnosed with Broca's aphasia, apraxia of speech and dysarthria, and presented signs of a moderate right-side hemiparesis. F.V. is able to walk unassisted and wears a brace on her right hand the majority of the day. At the time of her stroke, F.V. was employed as a dental hygienist and dental hygiene instructor at a local community college, having earned an Associate's degree. She continues to live independently near family, and continues to live a somewhat social lifestyle. Since January, 2009, F.V. has received traditional speech and language therapy services through the Asheville Aphasia Treatment Program (AATP) sponsored by the Department of Communication Sciences and Disorders at Western Carolina University. She also received speech, occupational, and physical therapies at CarePartners in Asheville, N.C. in addition to attending the Asheville Aphasia Support

Group. She continued to attend the Aphasia Support Group while participating in this study; however, did not participate in other therapies. F.V. has made significant improvement in her speech and expressive language since her stroke. To facilitate functional communication she obtained an augmentative communication device in August, 2009. Although she is capable of navigating this device with minimal support, she chooses not to use it due to its complexity.

Upon enrollment in this study, F.V. was administered the BDAE-3 to assess the presence and severity of aphasia and AOS. Quantitative data are presented in Tables 1 and 2, whereas qualitative data are discussed here. F.V. responded appropriately to simple social questions, including her full name and address. Expressive language impairments were evident during free conversation and picture description tasks. Free conversation was characterized by agrammatic utterances, such as, “Yes, um, yes, Joan…for me at Dr. Knollman, Sally, dental hygienist.” This behavior was also observed while describing the “cookie theft” picture; her response include statements such as, “Yes, cookies jars, um, yes, yes, yes…mother washes dishes, water, dishes.”

Auditory comprehension at word level was nearly intact; however, she continued to demonstrate difficulty understanding complex ideational material. F.V. followed one- and two-step commands without error; however, three steps commands (e.g., tap each shoulder twice with two fingers, keeping your eyes shut) proved too difficult. She demonstrated the greatest difficulty answering abstract yes-no questions and yes-no questions about short stories read aloud by the examiner.

As one component of the oral expression subtest, F.V. completed an oral agility task (e.g., pursing and relaxing the lips, opening and closing the mouth). She

Table 1

Summary profile of the standard subtests Conversational and Expository Speech, Auditory Comprehension, and Oral Expression of the Boston Diagnostic Aphasia Examination-Third Edition (BDAE-3) for Participant 1 (F.V.) administered prior to the onset of treatment.

Subtest	Task	Raw Score	Total Possible	Percentile
Fluency	Phrase Length	3	7	15
	Melodic Line	2	7	10
	Grammatical Form	4	7	30
Conversational and Expository Speech	Simple Social Responses	7	7	100
Auditory Comprehension	Basic Word Discrimination	32	37	40
	Commands	6	15	10
	Complex Ideational Material	4	12	15
Articulation	Nonverbal Agility	6	12	30
	Verbal Agility	7	14	30
	Articulatory Agility	3	7	30
Recitation & Music	Automatized Sequences	4	8	20
	Recitation	2	2	100
	Melody	2	2	100
	Rhythm	2	2	100
Repetition	Words	10	10	100
	Sentences	2	10	35
Naming	Responsive Naming	5	20	25
	Boston Naming Test	17	60	25
	Special Categories	9	12	25
Paraphasia	Phonemic	4	27	40
	Verbal	0	19	100
	Neologistic	0	11	100
	Multi-word	0	15	100

Table 2

Summary profile of the standard subtests Reading and Writing of the Boston Diagnostic Aphasia Examination-Third Edition (BDAE-3) for Participant 1 (F.V.) administered prior to the onset of treatment.

Subtest	Task	Raw Score	Total Possible	Percentile
Reading	Matching Cases & Scripts	8	8	100
	Number Matching	11	12	40
	Picture-Word Matching	6	10	15
	Lexical Decision	5	5	100
	Homophone Matching	0	5	0
	Free Grammatical Morphemes	4	10	5
	Oral Word Reading	23	30	40
	Oral Sentence Reading	4	10	50
	Oral Sentence Comprehension	4	5	50
	Sentence/Paragraph Comprehension	6	10	30
Writing	Form	15	18	20
	Letter Choice	25	27	60
	Motor Facility	9	18	20
	Primer Words	5	6	40
	Regular Phonics	1	5	30
	Common Irregular Words	0	5	20
	Written Picture Naming	1	12	20
	Narrative Writing	0	11	0

demonstrated difficulty with rapidly executing the movements with accuracy. She achieved few accurate repetitive movements when pursing and releasing lips, opening and closing mouth, retracting and releasing lips, alternating corners of mouth with tongue, protruding and retracting tongue, and moving tongue between upper and lower teeth. When completing tasks of verbal agility, such as repeatedly saying words and phrases as rapidly as possible, F.V. was able to produce words with fewer articulatory changes and greater familiarity. However, longer words and phrases with greater phonemic complexity and more syllables were difficult. She was able to achieve only very few movements with all words and phrases. Additionally, she produced words such as "mama" and "thanks" with no articulatory errors, but consistently made articulatory errors with the words and phrases "tip-top," "fifty-fifty," "huckleberry," "baseball player," and "caterpillar." When instructed to state the days of the week, months of the year, and the alphabet, she did so with some difficulty. She named the days of the week Sunday through Wednesday, months of the year January through April, and the alphabet through the letter "I." F.V. was able to count 1 to 21 with no errors. She was able to adequately recite familiar rhymes, produce the melodies of familiar songs, and imitate rhythms demonstrated by the examiner. Repetition was assessed by instructing the participant to repeat words, phrases, and sentences of increasing difficulty. F.V. was able to repeat all single words and some short phrases presented to her; however, breakdown occurred when repeating sentences of more than 3 words. To assess naming ability, F.V. was asked a series of questions requiring a single word response (e.g., "What do we tell time with?"), and she was able to correctly answer 4 of these, requiring additional response time on 3 of these correct responses. Performance on the BNT revealed moderate to severe anomia; F.V. named seven items spontaneously and without cues. Of the stimulus items requiring a phonemic or semantic cue, F.V. correctly named nine and ten targets following the cue, respectively. She was successful when naming letters and numbers aloud; however, she demonstrated considerable difficulty when naming colors.

The reading subtest began with perfect performance on matching letters according to case and script, and nearly perfect performance on number matching. She responded correctly to 6 of 10 picture-word matches, and identified a nonsense word presented in a group of real words with 100% accuracy. She was unable to identify homophones when presented graphemically, and had difficulty identifying the written form of free grammatical morphemes when presented orally by the examiner. Oral reading of single words was nearly intact; however, she demonstrated greater difficulty when reading at the sentence level. When provided with a four choices, F.V. was able to complete short sentences most of the time; however, when difficulty increased to paragraph level, she was unable to complete the task.

F.V. demonstrated writing mechanics near normal limits when writing; however, producing well-formed letters was determined to be effortful for her. She correctly wrote her name, more than half of the alphabet, and some numbers. F.V. wrote some basic vocabulary presented orally by the examiner, but had increasing difficulty with longer words, such as “apartment,” “tomato,” “backbone,” and “telegram.” Writing the names of pictured items and writing a picture narrative proved most difficult for her.

Overall, F.V.’s verbal expression is characterized by agrammatic speech and frequent pauses, likely associated with the presence of a moderate to severe anomia.

Although she is able to understanding single words with relative ease, she becomes overwhelmed during conversational speech and when large amounts of information are provided in a single utterance. Single word repetition was determined to be relatively intact, and sufficient for the completion of the treatment protocol utilized in the present study. Repetition of articulatory complex words and longer sentences proved more difficult. Reading and writing were judged to be functional on a basic level; however, moderate impairments in both areas were measured. Her performance on the BDAE-3 is consistent with moderate to severe Broca's aphasia.

Certain aspects of the BDAE-3 can also be used to gauge the presence and severity of AOS. In this case, F.V. demonstrated difficulty with oral agility tasks and verbal agility tasks, especially when asked to produce articulatory complex and lengthy words, phrases, and sentences. She was unable to repeat sentences of more than 3 words in length; again, this was more difficult as articulatory complexity and sentence length increased. These data suggest that F.V. presents with a mild to moderate AOS.

Upon enrollment in this study, F.V.'s primary caregiver, her mother, was asked to complete the ASHA FACS. These data are presented in Table 3. On the social communication and communication of basic needs subtests, F.V. was given a score of 87 out of 147 and 42 out of 42, respectively. F.V. was given a score of 59 out of 70 on the reading, writing, and number concepts subtest, with her perceived difficulty being completing forms. Daily planning was determined to be an additional strength of F.V.'s; she earned a score of 26 out of 28 on this subtest. Her perceived difficulties were primarily related to verbal expression and auditory comprehension. Difficulties specific to expression include requesting information, providing explanations, expressing opinion,

Table 3

Summary of Communication Independence Scales of the ASHA FACS before treatment for Participant 1 (F.V.).

Communication Independence Scales	Pre-Treatment
Social Communication	4.1
Basic Needs Communication	7.0
Reading, Writing, Number Concepts	5.9
Daily Planning	6.5
OVERALL	5.9

exchanging information on the telephone, adding information to conversations, and interacting in groups. Those related to comprehension include answering questions, understanding in noise or other distractions. Changing of conversational topic was also identified as an area of difficulty, and it was indicated that F.V.'s conversational partners carry out the majority of the conversation. In terms of her functional communication strengths, it was perceived that F.V. does relatively well understanding the general idea of conversations, and is able to communicate her basic needs some of the time despite the expressive language impairment. Letter and number skills were perceived to be adequate in that she is able to generally understand content presented to her in graphemic or numerical form, and is able to explain her thoughts using numbers and written language approximately half of the time.

Participant 2: Participant 2 (W.J.) was a 44-year-old Caucasian female who experienced a hemorrhagic stroke in 2005. She was diagnosed with Broca's aphasia and AOS at this time. Despite the presence of a moderate right-side hemiparesis, W.J. is able to walk unassisted. At the time of her stroke, W.J. was employed as a labor and delivery nurse, having earned a Bachelor's degree. She continues to live independently with her husband and six children, and lives a very social lifestyle.

Since January, 2009, W.J. received traditional speech and language therapy services through the Asheville Aphasia Treatment Program (AATP) sponsored by the Department of Communication Sciences and Disorders at Western Carolina University. Prior to enrolling in AATP, she received speech, occupational, and physical therapies at CarePartners in Asheville, N.C. W.J. was not receiving speech-language services at the time of this study, but was involved in the Asheville Aphasia Support Group.

Although W.J. has made significant improvements in her speech and expressive language since her stroke, she continues to demonstrate moderate anomia. This has made interacting with various communication partners more difficult, especially when the communication partners are unfamiliar with her communication abilities. W.J. obtained an augmentative communication device, and uses it extensively. She uses the device as a compensatory tool when her communication attempts fail, and she does not require assistance or prompting to do so.

Upon enrollment in this study, W.J. was administered the BDAE-3 to assess the presence and severity of aphasia and AOS. Quantitative data are presented in Tables 4 and 5, whereas qualitative data are discussed here. W.J. responded appropriately to simple social questions, including her full name and address. Expressive language impairments were evident during free conversation and picture description tasks. Free conversation was characterized by agrammatic utterances, such as, "Nurse at Mission…had stroke." This behavior was also observed while describing the "cookie theft" picture; her response include statements such as, "Boy…how can I tell you…cookie…falling…mother wash."

Auditory comprehension at word level was nearly intact; however, she continued to demonstrate difficulty understanding complex ideational material. W.J. followed one, two, and three-step commands without difficulty. She demonstrated the greatest difficulty answering abstract yes-no questions and yes-no question about short stories read aloud by the examiner.

As one component of the oral expression subtest, W.J. completed an oral agility task (e.g., pursing and relaxing the lips, opening and closing the mouth). She

Table 4

Summary profile of the standard subtests Conversational and Expository Speech, Auditory Comprehension, and Oral Expression of the Boston Diagnostic Aphasia Examination-Third Edition (BDAE-3) for Participant 2 (W.J.) administered prior to the beginning of treatment.

Subtest	Task	Raw Score	Total Possible	Percentile
Fluency	Phrase Length	6	7	30
	Melodic Line	3	7	20
	Grammatical Form	4	7	30
Conversational and Expository Speech	Simple Social Responses	7	7	100
Auditory Comprehension	Basic Word Discrimination	22.5	37	5
	Commands	15	15	100
	Complex Ideational Material	7	12	40
Articulation	Nonverbal Agility	12	12	100
	Verbal Agility	0	14	0
	Articulatory Agility	3	7	30
Recitation & Music	Automatized Sequences	4	8	20
	Recitation	2	2	100
	Melody	2	2	100
	Rhythm	2	2	100
Repetition	Words	7	10	30
	Sentences	0	10	10
Naming	Responsive Naming	2	20	10
	Boston Naming Test	8	60	20
	Special Categories	12	12	100
Paraphasia	Phonemic	3	27	30
	Verbal	0	19	100
	Neologistic	0	11	100
	Multi-word	0	15	100

Table 5

Summary profile of the standard subtests Reading and Writing of the Boston Diagnostic Aphasia Examination-Third Edition (BDAE-3) for Participant 2 (W.J.) administered prior to the beginning of treatment.

Subtest	Task	Raw Score	Total Possible	Percentile
Reading	Matching Cases & Scripts	8	8	100
	Number Matching	12	12	100
	Picture-Word Matching	10	10	100
	Lexical Decision	4	5	30
	Homophone Matching	3	5	40
	Free Grammatical Morphemes	4	10	5
	Oral Word Reading	0	30	0
	Oral Sentence Reading	0	10	10
	Oral Sentence Comprehension	3	5	30
	Sentence/Paragraph Comprehension	6	10	30
Writing	Form	18	18	100
	Letter Choice	23	27	30
	Motor Facility	9	18	20
	Primer Words	3	6	20
	Regular Phonics	0	5	20
	Common Irregular Words	0	5	20
	Written Picture Naming	0	12	10
	Narrative Writing	2	11	15

demonstrated no difficulty with rapidly executing the movements. She earned perfect scores when pursing and releasing lips, opening and closing mouth, retracting and releasing lips, alternating corners of mouth with tongue, protruding and retracting tongue, and moving tongue between upper and lower teeth. However, when completing tasks of verbal agility, W.J. exhibited remarkable difficulty producing words, regardless of the degree of articulatory complexity. She had difficulty producing longer words and phrases with phonemic complexity and multiple syllables, such as “tip-top,” “fifty-fifty,” “huckleberry,” “baseball player,” and “caterpillar.” She was unable to name the days of the week and only the months of January and February. Although she was able to count to 21, she was only able to state the alphabet through the letter “G.” She was able to adequately recite familiar rhymes, produce the melodies of familiar songs, and imitate rhythms demonstrated by the examiner. W.J. was able to repeat the majority of single words and some short phrases presented to her; however, breakdown occurred when repeating sentences of more than three words. To assess naming ability, W.J. was asked a series of questions requiring a single word response (e.g., “What do we tell time with?”), and she was able to correctly answer one of these. Performance on the BNT revealed significant anomia; W.J. named 0 items spontaneously and without cues. Of the stimulus items requiring a phonemic or semantic cue, W.J. correctly named 8 and 0 targets following the cue, respectively. She was successful when naming letters and numbers aloud; however, she demonstrated considerable difficulty when naming colors.

On the reading subtest, W.J. successfully completed tasks of matching letters according to case and script and number matching. She responded correctly to all picture-word matches, and identified a nonsense word presented in a group of real words without error. W.J. was able to identify the majority of homophones when presented graphemically, but had difficulty identifying the written form of free grammatical morphemes when presented orally by the examiner. Oral reading of single words was very difficult as was reading at the sentence level. When provided with a four choices, W.J. was able to complete short sentences most of the time; however, when difficulty increased to paragraph level, she was unable to complete the task.

W.J. demonstrated writing mechanics near normal limits when writing. She correctly wrote her name, all of the alphabet, and some numbers. W.J. wrote some basic vocabulary presented orally by the examiner, but had increasing difficulty with longer words, such as “apartment,” “tomato,” “backbone,” and “telegram.” Writing the names of pictured items and writing a picture narrative proved most difficult for her.

Overall, W.J.’s verbal expression is characterized by agrammatic speech and frequent pauses, likely associated with the presence of a moderate to severe anomia. Auditory comprehension was determined to be relatively intact. Single word repetition was determined to be relatively intact, and sufficient for the completion of the treatment protocol utilized in the present study. Repetition of articulatory complex words and longer sentences proved more difficult. Reading and writing were judged to be functional on a basic level; however, moderate impairments in both areas were measured. Her performance on the BDAE-3 is consistent with moderate to severe Broca’s aphasia.

Certain aspects of the BDAE-3 can also be used to gauge the presence and severity of AOS. In this case, W.J. demonstrated difficulty with verbal agility tasks, especially when asked to produce articulatory complex and lengthy words, phrases, and sentences. She was unable to repeat sentences of more than three words in length; again, this was more difficult as articulatory complexity and sentence length increased. These data suggest that W.J. presents with a mild to moderate AOS.

Upon enrollment in this study, W.J.'s primary caregiver, her husband, was asked to complete the ASHA FACS. These data are presented in Table 6. On the social communication and communication of basic needs subtests, W.J. was given a score of 132 out of 147 and 49 out of 49, respectively. W.J. was given a score of 48 out of 70 on the reading, writing, and number concepts subtest, with her perceived difficulty being using common reference materials, following written directions, understanding basic printed material, filling out short forms, and writing messages. Daily planning was determined to be an additional strength for W.J.; she earned a score of 31 out of 35 on this subtest. Her perceived difficulties were primarily related to following a map. Changing of conversational topic was also identified as an area of difficulty, and it was indicated that W.J.'s conversational partners carry out the majority of the conversation. In terms of her functional communication strengths, it was perceived that W.J. does relatively well understanding the general idea of conversations, and is able to communicate her basic needs some of the time despite the expressive language impairment. Letter and number skills were perceived to be adequate in that she is able to generally understand content presented to her in graphemic or numerical form, and is able to explain her thoughts using numbers and written language approximately half of the time.

Treatments

A single-subject design utilizing alternating treatments was used to compare traditional speech-language therapy with music therapy (TRAD+M) to traditional

Table 6

Summary of Communication Independence Scales of the ASHA FACS before treatment for Participant 2 (W.J.).

Communication Independence Scales	Pre-Treatment
Social Communication	6.3
Basic Needs Communication	7.0
Reading, Writing, Number Concepts	4.8
Daily Planning	6.2
OVERALL	6.1

speech-language therapy without music therapy (TRAD). The data collected included rate of acquisition of targets during each treatment block and retention of targets at three- and six-weeks following the end of each treatment block. Three times weekly, participants participated in a 90-minute treatment session. During TRAD, the aphasia treatment was completed prior to the AOS treatment, and each lasted approximately 45-minutes. During TRAD+M, the aphasia, AOS, and music therapies, administered in this order, each lasted approximately 30-minutes. The treatment approach being used alternated every three weeks for a total of nine weeks, so that nine sessions of one treatment were followed by nine sessions of the other, followed by nine sessions of the first treatment.

TRAD proceeded in the following manner: At the beginning of each session after the first, the participants were instructed to name the five targets trained in the previous session. If an incorrect response was given, the clinician provided the correct response and instructed the participant to repeat it. The target was then included as a target in that treatment session. Mastered targets were replaced by a new treatment target.

The impairment associated with aphasia targeted in this treatment was anomia, or impaired word retrieval and naming. To treat this impairment, Cueing Hierarchy (CH) was utilized. In CH, ten levels of cueing ranging from no cue to repetition of the target are utilized (Table 7). Successive levels of the hierarchy were presented until the participant produced the target. Once the appropriate response had been elicited, the order of stimulus presentation was reversed. Beginning with the level at which the word was elicited, the cues were then presented in the order of successively decreasing stimulus power through level one. If at any level the participant was unable to respond,

Table 7

Steps to Cueing Hierarchy, with an example for the target "pan."

Steps	Example
1. Directions to name the item.	What is this?
2. Directions to state the function of the item.	What is it used for?
3. Directions to demonstrate the function.	Show me what it is used for.
4. Statement of the function by the clinician.	You cook with it.
5. Statement and demonstration of the function by the clinician.	You cook with it like this.
6. Sentence completion.	To cook bacon, I use a frying _____.
7. Sentence completion and silent production of initial phoneme.	To cook bacon, I use a frying [p] _____.
8. Sentence completion and vocalized production of initial phoneme.	To cook bacon, I use a frying /p/ _____.
9. Sentence completion and vocalized production of first two phonemes.	To cook bacon, I use a frying /pæ/ _____.
10. Directions to repeat target after the clinician.	Repeat after me, pan.

the order of stimulus presentation was again reversed and successively more powerful cues were provided until the word was produced. Then the order was once more reversed. This pattern of cues was utilized until the target was independently named when the stimulus picture is presented.   Five targets were trained in each session.

The traditional AOS treatment utilized was the Eight-Step Task Continuum (Rosenbek, Lemme, Ahern, Harris, & Wertz, 1973). This approach was administered following the aphasia treatment, and lasted approximately 45-minutes. For the present study, a shortened version of this approach was utilized. As a modification from the original protocol, the target utterances were trained at the single word level, progressing from Step 1 to Step 4. The four steps of this approach utilized in the present investigation are presented in Table 8. Additional steps were not utilized at this time due to the writing requirements of these levels and a diagnosis of agraphia for both participants. The Eight-Step Task Continuum requires the clinician to demonstrate an appropriate production of a target, followed by the simultaneous production of the target with the client. Criterion for moving to the next step in the continuum was 80% correct in 20 consecutive stimulus trials. Importantly, during the TRAD portion, the targets were trained at the word level.

TRAD+M proceeded in a manner similar to TRAD; the only difference between the protocols was the addition of music therapy following the traditional treatments. The music therapy protocol utilized in this study was based on that of Kim and Tomaino (2008), with the deletion of one step (i.e., vocal intonation). The protocol included six different musically assisted speech techniques, as presented in Table 9. Singing familiar songs is the first step of the protocol, followed by slow and gentle breathing of consonant-vowel-consonant syllables. Familiar melodies are then utilized while

Table 8

Steps and examples to the first four steps of the Eight-Step Task Continuum utilized in this study.

Steps	Example
1. Integral Stimulation	"Watch me, listen to me," plus simultaneous production of target utterance by client and clinician
2. Integral Stimulation and Delayed Production	Clinician models target utterance then client produces target utterance while clinician produces target utterance without sound
3. Integral Stimulation and Delayed Production with No Visual Cue	"Watch me, listen to me, now you say it"
4. Integral Stimulation and Successive Productions	Clinician models target utterance then client produces target utterance several times without cues

Table 9

The music therapy protocol, with examples, utilized in the present investigation.

Steps	Example
1. Singing familiar songs	Singing “Happy Birthday”
2. Breathing into single-syllable sounds	Gently exhaling with vocal sounds
3. Musically assisted speech	Using familiar melodies with novel phrases
4. Dynamically cued singing	Varying loudness and pausing during singing
5. Rhythmic speech cueing	Clapping along with speech rhythm
6. Oral motor exercises	Singing familiar songs with exaggerated mouth and tongue movements

producing novel phrases. Step 4 incorporates loudness variations and pauses during singing, and the fifth step adds clapping. Finally, oral-motor exercises are incorporated into the singing of familiar songs to help improve oral motor formations. Songs were used in Steps 3 through 6, and included, “Happy Birthday,” “Twinkle, Twinkle Little Star,” “You Are My Sunshine,” “Baa, Baa Black Sheep,” and “Three Blind Mice.” The song during each treatment session was randomly chosen at the start of the session. Importantly, during the TRAD+M, the targets were trained at the word, phrase and sentence levels.

Treatment Targets

Prior to baselining naming treatment targets, AOS treatment targets were baselined. To select AOS treatment targets appropriate for each participant, a baselining probe was administered in three consecutive sessions. The participant was asked to repeat three consonant-vowel-consonant (CVC) words with each consonant phoneme of the English language in the initial position of the word. After identifying a closed set of phonemes the participant was unable to repeat in the initial position of the word, three of these phonemes were selected as treatment targets to be trained. A list of targets to be baselined for the naming treatment was then compiled and targets were baselined in three consecutive sessions for each participant. Drawings and photographs of common objects were presented on 3X4 index cards, and the participant was instructed to name each aloud. After identifying a closed set of words the participant was unable to name in three consecutive sessions, 75 of these were selected as treatment targets to be trained, resulting in 25 baselined targets per treatment. These targets were randomly assigned to one of the three treatment blocks, balancing as much as possible for semantic category, frequency, and word length. All targets within each treatment block began with the same initial phoneme. The remaining baselined targets were held in reserve in the event that additional targets are required for treatment. The phoneme targets were randomly assigned to one of the treatment blocks. Sounds and words utilized during the music therapy component of TRAD+M included only those words and phonemes targeted in the aphasia and AOS treatments of the TRAD+M treatment block, respectively. In addition, each treatment block utilized a unique set of treatment targets; the targets trained in one treatment block were not used in other treatment blocks. A list of treatment targets for each treatment block is presented in Table 10.

Mastery of Items

Mastery of naming treatment targets was assessed in the beginning of each session by presenting targets trained in the previous session. An item was considered mastered when a correct response was spontaneously produced at that time in two consecutive sessions. Mastered targets were replaced by a new target for that treatment block. In the case of an incorrect response, the item continued to be trained until the mastery criterion was met.

Generalization and Post-Treatment Probes

To assess generalization of treatment to untrained items, those targets held in reserve were assessed at the completion of each treatment block. Participants were presented with the untrained targets on 3X4 index card and were instructed to name them aloud. The participants' abilities to correctly and spontaneously name the untrained were recorded.

Table 10. Treatment targets selected for each treatment block.

TRAD (A)	TRAD+M	TRAD(A2)
popcorn, pepper, pink, potato, pie, puzzle, pipe, pan, pear, pencil, peach, pig, penguin, pants, pin, pizza, parachute, popsicle, paintbrush, pearls, palace, passport, parrot, pentagon, palm tree	sad, sack, sandwich, soccer, seven, sunglasses, seatbelt, sailboat, singer, sink, salt, soup, sun, saw, soap, seal, supplies, cereal, cell phone, sandals, safe, seesaw, saddle, Santa, sock	baker, belt, bicycle, backpack, bagpipe, bird, baseball, beard, bunny, banana, bee, bull, bowtie, beachball, boat, butterfly, bathtub, ballerina, bedroom, bubblegum, birdhouse, baboon, buzzard, basketball, bowling

To assess maintenance of mastered targets over time, two post-treatment probes were administered 3- and 6-weeks after the completion of TRAD(A1), TRAD+M, and TRAD(A2). At this time, participants were presented with all trained targets on 3X4 index card, and were instructed to name them aloud. Ability to name the trained targets was recorded.

Procedure

Informed consent approved by the Institutional Review Board at Western Carolina University was obtained from both participants prior to study participation. Once informed consent was obtained, three baseline sessions to establish target words and the BDAE-3 were then administered. Caregivers were also asked to complete the ASHA FACS prior to the onset of treatment and after the final treatment block. Treatment began within one week of speech-language testing and baselining of treatment targets.

Participants completed a 90-minute treatment session three times each week for nine weeks. Using an ABA design, both participants completed TRAD therapy for three weeks (i.e., TRAD(A1)) followed by TRAD+M therapy for three weeks, then returning to TRAD therapy for the final three weeks (i.e., TRAD(A2)). During both administrations of the TRAD therapy, the CH therapy approach was utilized to target impaired naming, and lasted for 45 minutes of the session. Immediately following the aphasia treatment, the modified Eight-Step Task Continuum was administered for approximately 45 minutes to target AOS. The TRAD+M treatment was very similar; however, the aphasia and AOS treatments were each completed for 30 minutes of the session. The remaining 30 minutes of the session were dedicated to using the music therapy.

Post-treatment probes for the TRAD(A1), TRAD+M, and TRAD(A2) were administered at 3- and 6-weeks following the end of each treatment.

All study-related sessions were completed at Western Carolina University facilities in Asheville, NC (Department of Nursing, Asheville-Buncombe Technical Community College-Enka Campus) or in the participants' homes. Two sessions per week were held at F.V.'s home due to transportation conflicts. A total of three sessions were held at W.J.'s home also due to transportation conflicts.

CHAPTER 3

RESULTS

Response to Treatment

Participant 1: F.V. demonstrated a positive response to treatment in terms of mastery of trained targets, generalization to untrained targets, performance on the BDAE-3 following treatment, and ratings on the ASHA FACS following treatment. Throughout the study, she participated well during each treatment session and was comfortable participating in all music therapy tasks. Due to a transportation conflict, F.V. missed a scheduled session during Week 2 of treatment (i.e., TRAD(A1)) and was unable to make up the session.

Upon completion of this study, F.V. was re-administered the BDAE-3 to assess changes in speech and language function in response to participating in this study. These data are presented in Tables 11 and 12 with pre-treatment assessment data. It was determined that following treatment, F.V.'s performance on the simple social responses, free conversation, and picture description tasks remained unchanged. However, the frequency of perserverative responses during the free conversation task decreased dramatically upon the second administration of the test. Auditory comprehension improved in terms of single word comprehension, following directions, and in answering yes-no questions in response to questions and stories read aloud.; scores increased 1.5, 5, and 2 points, respectively. Nonverbal agility remained consistent; however, verbal agility and automatized sequences increased slightly from 7 to 8 and 4 to 6, respectively. Recitation, melody, and rhythm scores remained unchanged, as did her performance on

Table 11

Summary profile of the standard subtests Conversational and Expository Speech, Auditory Comprehension, and Oral Expression of the Boston Diagnostic Aphasia Examination-Third Edition (BDAE-3) for Participant 1 (F.V.) administered before the beginning of treatment and after the final treatment block.

Subtest	Task	Pre-Treatment	Post-Treatment	Total Possible
Fluency	Phrase Length	3	3	7
	Melodic Line	2	3	7
	Grammatical Form	4	4	7
Conversational and Expository Speech	Simple Social Responses	7	7	7
Auditory Comprehension	Basic Word Discrimination	32	33.5	37
	Commands	6	11	15
	Complex Ideational Material	4	6	12
Articulation	Nonverbal Agility	6	6	12
	Verbal Agility	7	8	14
	Articulatory Agility	3	5	7
Recitation & Music	Automatized Sequences	4	6	8
	Recitation	2	2	2
	Melody	2	2	2
	Rhythm	2	2	2
Repetition	Words	10	10	10
	Sentences	2	3	10
Naming	Responsive Naming	5	11	20
	Boston Naming Test	17	24	60
	Special Categories	9	12	12
Paraphasia	Phonemic	4	4	27
	Verbal	0	0	19
	Neologistic	0	0	11
	Multi-word	0	0	15

Table 12

Raw scores of the summary profile of the standard subtests Reading and Writing of the Boston Diagnostic Aphasia Examination-Third Edition (BDAE-3) for Participant 1 (F.V.) administered before the beginning of treatment and after the final treatment block.

Subtest	Task	Pre-Treatment	Post-Treatment	Total Possible
Reading	Matching Cases & Scripts	8	8	8
	Number Matching	11	12	12
	Picture-Word Matching	6	8	10
	Lexical Decision	5	5	5
	Homophone Matching	0	1	5
	Free Grammatical Morphemes	4	7	10
	Oral Word Reading	23	30	30
	Oral Sentence Reading	4	4	10
	Oral Sentence Comprehension	4	5	5
	Sentence/Paragraph Comprehension	6	7	10
Writing	Form	15	15	18
	Letter Choice	25	25	27
	Motor Facility	9	9	18
	Primer Words	5	0	6
	Regular Phonics	1	0	5
	Common Irregular Words	0	0	5
	Written Picture Naming	1	0	12
	Narrative Writing	0	0	11

repetition tasks. Responsive naming increased from 5 to 11 by the end of study participation, and her performance on the BNT also increased from 17 to 24. Naming of letters, numbers, and colors increased from 4 to 6. Reading scores remained consistent in case and script matching tasks and increased from 11 to 12 on the number matching task. Her scores remained consistent on the lexical decision and oral reading of sentences with comprehension tasks. Performance increased from 6 to 8 on the picture word matching task, 0 to 1 on the homophone matching task, 4 to 7 on the matching to spoken words task, and 23 to 30 on the basic oral reading task. Her comprehension of oral reading of sentences and reading comprehension of sentences paragraphs increased from 4 to 5 and 6 to 7, respectively. On the writing subtest, F.V's scores remained the same in well-formedness of letters, correctness of letter choice, motor facility in the mechanics of writing, and narrative writing. Other writing scores decreased. Performance on the dictated words of primer vocabulary task decreased from 5 to 0, and performance on dictated words with regular phonics decreased from 1 to 0. On the written picture naming task, her score decreased from 1 to 0.

Overall, her post-treatment performance on the BDAE-3 was positive; she improved her performance on many tasks of auditory comprehension, oral expression, and reading. The only subtest that revealed decreased performance was writing. As naming and speech production were treated in this study, it is worth highlighting that naming scores and verbal agility scores increased somewhat. This supports the efficacy of the present treatment procedures to improve these language and speech processes.

Upon completion of this study, F.V.'s primary caregiver completed the ASHA FACS again to assess changes in F.V.'s functional communication abilities in response to participating in this treatment study. These pre- and post-treatment data are presented in Table 13. F.V.'s rating on the social communication subtest of the ASHA FACS suggested an increase in performance from 87 to 113. Specific areas of perceived improvement included requesting, explaining, talking on the phone, and switching topics. Her ability to communicate her basic needs remained at the maximum of 42. In terms of her reading, writing, and number skills, her perceived abilities decreased since the start of the treatment protocol from 59 to 49. Decreased performance was noted on tasks involving following and understanding written directions, filling out forms, and writing messages. On the final subtest, daily planning, it was determined that F.V.'s performance increased slightly from 26 to 27. Although near the maximum score of 28, it was indicated that she had difficulty with dialing the telephone. Additionally, her qualitative overall scores increased in social communication, communication of basic needs, and daily planning skills, which suggests that her expressive and receptive communication has improved in these areas. Her qualitative overall score remained the same in reading, writing, and number concept skills. Overall, F.V. was perceived to have excellent abilities in communicating her basic needs and daily planning, as well as good abilities in social communication. However, she was perceived to continue to have difficulty with writing.

The rate of acquisition data of mastered targets are presented in Figure1, and retention data of mastered, trained but not mastered, and untrained targets in each treatment block for F.V. are presented in Figures 2, 3, and 4, respectively. The number of targets trained and mastered and number of trained, mastered, and untrained targets produced during 3- and 6-weeks probes for F.V. are presented in Table 14. During the

Table 13

Summary of Communication Independence Scales of the ASHA FACS before and after treatment for Participant 1 (F.V.).

Communication Independence Scales	Pre-Treatment	Post-Treatment
Social Communication	4.1	5.4
Basic Needs Communication	7.0	7.0
Reading, Writing, Number Concepts	5.9	4.9
Daily Planning	6.5	6.8
OVERALL	5.9	6.0

Figure 1

Rate of acquisition of targets in each treatment block for F.V.

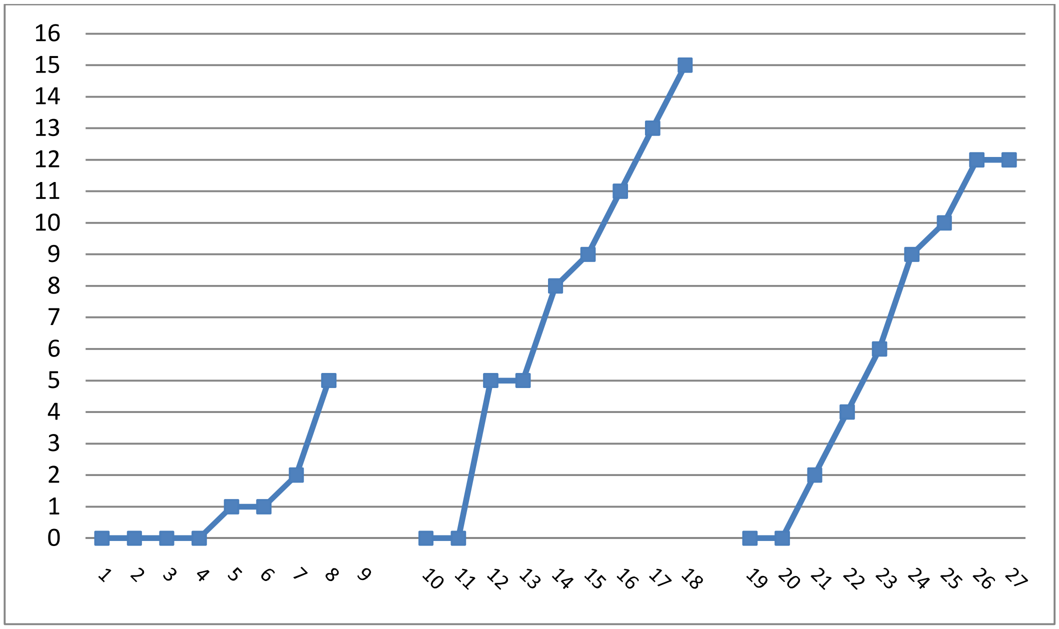


Figure 2

Retention rates of mastered targets at 3- and 6-weeks probes for all treatment blocks for F.V.

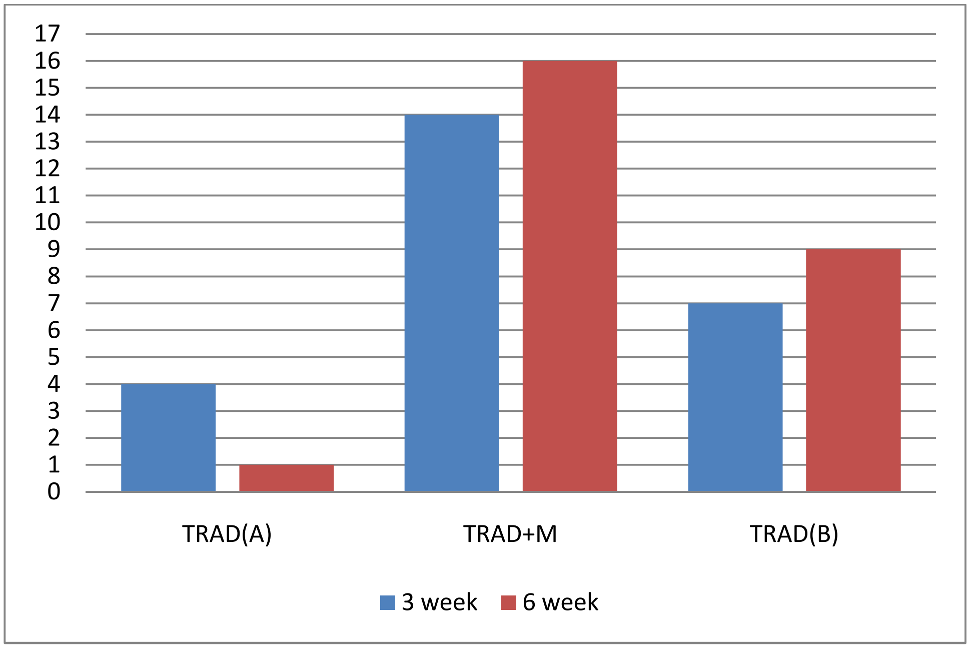


Figure 3

Retention rates of trained but not mastered targets at 3- and 6-weeks probes for all treatment blocks for F.V.

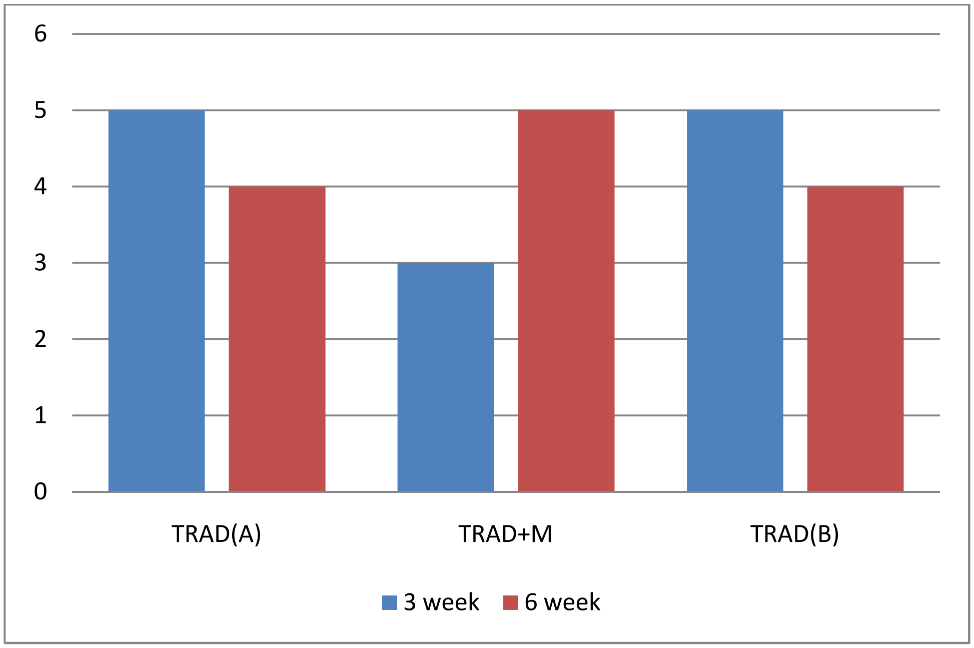


Figure 4

Generalization rates of untrained targets at 3- and 6-weeks probes for all treatment blocks for F.V.

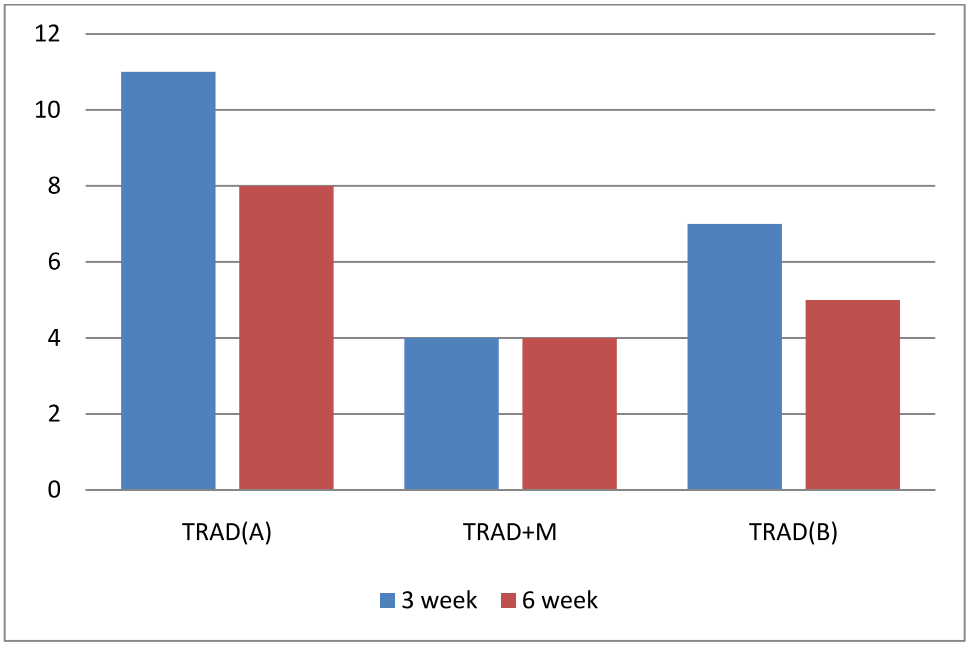


Table 14

Number of targets mastered and trained but not mastered targets, and number of mastered, trained but not mastered, and untrained targets produced during 3- and 6-weeks probes for F.V.

	Number Mastered	Number Trained not Mastered		3-week Probe	6-week Probe
TRAD(A1)	5	5	Mastered	4	1
			Trained	5	4
			Untrained	8	6
TRAD+M	16	5	Mastered	14	16
			Trained	3	5
			Untrained	4	4
TRAD(A2)	12	5	Mastered	7	9
			Trained	5	4
			Untrained	7	5

initial TRAD treatment (i.e., TRAD(A1)), F.V. was trained on ten unique targets. She demonstrated mastery of five of these trained items (i.e., pin, penguin, pipe, puzzle, pan). The trained targets she was unable to master included: pie, popcorn, pepper, pink, potato. These data indicate successful naming of targets that were trained and mastered, trained but not mastered, and untrained (i.e., generalization probes). F.V. was able to name four and one mastered targets at the 3- and 6-week probes, respectively. Of the five items trained during this treatment she was unable to master, she named five and four of the targets at the 3- and 6-weeks probes, respectively. Of the 15 items baselined for but not trained during the TRAD(A1) block, F.V. named 8 targets at the 3-week and 6 targets at the 6-week treatment probes. She was able to name the following untrained items at 3-weeks after the end of the TRAD(A1) treatment: pencil, peach, pig, pants, parachute, paintbrush, pearls, and palace. During the 6-week probe, she named the following untrained items: pear, pencil, peach, pants, parachute, and popsicle.

During the TRAD+M treatment, F.V. was trained on 21 unique targets. She demonstrated mastery of 16 of these trained items (i.e., saw, soap, sink, soccer, Santa, singer, sailboat, sunglasses, cereal, seatbelt, sack, cell phone, supplies, sandwich, seesaw, sad). The trained targets she was unable to master included safe, saddle, seven, sandals, and soup. F.V. was able to name 14 and 16 mastered targets at the 3- and 6-week probes, respectively. Of the 21 items trained but not mastered during this treatment, she was able to name 3 and 5 of the targets at the 3- and 6-week probes, respectively. Of the four items baselined for but not trained during the TRAD+M block, F.V. named four targets at the 3- and 6-week treatment probes, which included salt, sun, seal, sock.

During the TRAD(A2) treatment block, F.V. was trained on 17 unique targets. She demonstrated mastery of 12 of these trained items (i.e., banana, bowtie, beach ball, boat, butterfly, bathtub, bicycle, bedroom, belt, bowling, backpack, bagpipe). The trained targets she was unable to master included: baseball, baboon, bubblegum, buzzard, birdhouse. F.V. was able to name 7 and 9 mastered targets at the 3- and 6-week probes, respectively. Of the five items trained but not mastered during this treatment, she was able to name 5 and 4 of the targets at the 3- and 6-weeks probes, respectively. Of the eight items baselined for but not trained during the TRAD(A2) block, F.V. named seven targets at the 3-week and 5 targets at the 6-week treatment probes. She was able to name the following untrained items at 3-weeks after the end of the TRAD(A2) treatment: baker, bird, beard, bunny, bee, bull, basketball. During the 6-week probe, she named the following untrained items: bird, beard, bunny, bee, bull.

These data suggest that, for this participant, both treatment approaches were successful in improving naming and speech production. The TRAD+M treatment approach was more successful in improving naming of trained targets as determined by the acquisition of trained targets and better retention of mastered targets following this approach versus the TRAD(A1) and TRAD(A2) blocks. During the TRAD (A) probes, F.V. retained 4 (i.e., 80%) and 1 (i.e., 20%) of the five mastered targets at 3- and 6-weeks post treatment. Similar data were obtained during the TRAD(A2) retention probes; she retained 7 (i.e., approximately 58%) and 9 (i.e., approximately 75%) of the 12 targets mastered. The greatest retention of mastered items was observed following the TRAD+M block, and she retained 14 (approximately 87%) and 16 (i.e., 100%) of the 16 targets mastered 3- and 6-weeks following treatment.

Generalization to untrained targets was remarkable for all treatment blocks. Visual inspection of the data would suggest that TRAD(A1) demonstrated the most generalization to untrained targets and TRAD+M demonstrated the least generalization. However, if considering the percentage of untrained targets produced at the 3- and 6-week retention probes, this is not the case. Of the 15 targets untrained in TRAD(A1), F.V. was able to name approximately 53% and 40% of those targets at the 3- and 6-week retention probes. She was able to name 100% of the four untrained TRAD+M targets. This suggests that F.V. demonstrated generalization to untrained items, and the percentage of untrained targets named was greatest for TRAD+M. These data together suggest that for F.V., the TRAD+M treatment protocol yielded the greatest outcome in terms of mastered targets, retention of targets, and generalization to untrained targets when compared to the TRAD treatment approach.

Participant 2: W.J. demonstrated an overall positive response to treatment. She was highly motivated to participate during each treatment session and attempted all singing tasks presented to her. Due to a transportation conflict, W.J. missed one treatment session during Week 2 (i.e., TRAD(A1)) and during Week 5 (i.e., TRAD+M); both of these sessions were made-up.

Upon completion of this study, W.J. was re-administered the BDAE-3 to assess changes in speech and language function in response to participating in this study. These data are presented in Tables 15 and 16 with pre-treatment assessment data. It was determined that following treatment, W.J.'s performance on the simple social responses and free conversation tasks remained unchanged. However, while the frequency of perserverative responses during the picture description task increased dramatically upon

Table 15

Summary profile of the standard subtests Conversational and Expository Speech, Auditory Comprehension, and Oral Expression of the Boston Diagnostic Aphasia Examination-Third Edition (BDAE-3) for Participant 2 (W.J.) administered before the beginning of treatment and after the final treatment block.

Subtest	Task	Pre-Treatment	Post-Treatment	Total Possible
Fluency	Phrase Length	6	7	7
	Melodic Line	3	4	7
	Grammatical Form	4	4	7
Conversational and Expository Speech	Simple Social Responses	7	7	7
Auditory Comprehension	Basic Word Discrimination	22.5	33.5	37
	Commands	15	15	15
	Complex Ideational Material	7	8	12
Articulation	Nonverbal Agility	12	12	12
	Verbal Agility	0	4	14
	Articulatory Agility	3	4	7
Recitation & Music	Automatized Sequences	4	4	8
	Recitation	2	2	2
	Melody	2	2	2
	Rhythm	2	2	2
Repetition	Words	7	8	10
	Sentences	0	1	10
Naming	Responsive Naming	2	5	20
	Boston Naming Test	8	10	60
	Special Categories	12	12	12
Paraphasia	Phonemic	3	3	27
	Verbal	0	0	19
	Neologistic	0	0	11
	Multi-word	0	0	15

Table 16

Raw scores of the summary profile of the standard subtests Reading and Writing of the Boston Diagnostic Aphasia Examination-Third Edition (BDAE-3) for Participant 2 (W.J.) administered before the beginning of treatment and after the final treatment block.

Subtest	Task	Pre-Treatment	Post-Treatment	Total Possible
Reading	Matching Cases & Scripts	8	8	8
	Number Matching	12	12	12
	Picture-Word Matching	10	10	10
	Lexical Decision	4	4	5
	Homophone Matching	3	4	5
	Free Grammatical Morphemes	4	8	10
	Oral Word Reading	0	4	30
	Oral Sentence Reading	0	1	10
	Oral Sentence Comprehension	3	5	5
	Sentence/Paragraph Comprehension	6	7	10
Writing	Form	18	18	18
	Letter Choice	23	23	27
	Motor Facility	9	9	18
	Primer Words	3	3	6
	Regular Phonics	0	0	5
	Common Irregular Words	0	0	5
	Written Picture Naming	0	0	12
	Narrative Writing	2	2	11

the second administration of the test, it should be noted that she provided a much more illustrative narration of the activities in the picture than in the initial testing. Auditory comprehension remained the same in following directions and improved in terms of single word comprehension and in answering yes-no questions in response to questions and stories read aloud.; scores increased 11 and 1 points, respectively. Nonverbal agility remained consistent; however, verbal agility increased greatly from 0 to 4 and automatized sequences remained the same. Recitation, melody, and rhythm scores remained unchanged. Her performance on repetition tasks increased from 7 to 8 on single words and 0 to 1 on sentences. Responsive naming increased from 2 to 5 by the end of study participation, and her performance on the BNT also increased from 8 to 10. Naming of letters, numbers, and colors remained the same. Reading scores remained consistent in case and script matching and number matching tasks. Her scores remained consistent on the picture-word match and lexical decision tasks. Performance increased from 3 to 4 on the homophone matching task, 4 to 8 on the matching to spoken words task, and 0 to 4 on the basic oral reading task. Her comprehension of oral reading of sentences and reading comprehension of sentences paragraphs increased from 0 to 1 and 3 to 5, respectively. On the writing subtest, W.J.'s scores remained the same in well-formedness of letters, correctness of letter choice, motor facility in the mechanics of writing, and narrative writing. Performance on the dictated words of primer vocabulary, dictated words with regular phonics, and written picture naming tasks remained the same.

Overall, her post-treatment performance on the BDAE-3 was positive; she improved her performance on many tasks of auditory comprehension, oral expression, and reading. No subtests revealed decreased performance. As naming and speech production were treated in this study, it is worth highlighting that naming scores and verbal agility scores increased.

Upon completion of this study, W.J.'s primary caregiver again completed the ASHA FACS to assess changes in W.J.'s functional communication abilities in response to participating in this treatment study. These pre- and post-treatment data are presented in Table 17. W.J.'s rating on the social communication subtest of the ASHA FACS suggested an increase in performance from 132 to 140. Specific areas of perceived improvement included referring to familiar people by name, explaining how to do something, adding new information on as topic in a conversation, changing topics in conversation, and adjusting to a change in topic by conversational partner. Her ability to communicate her basic needs remained at the maximum of 49. In terms of her reading, writing, and number skills, her perceived abilities increased since the start of the treatment protocol from 48 to 60. Specific areas of perceived improvement included using common reference materials, following written directions, understanding basic printed material, and writing messages. On the final subtest, daily planning, it was determined that W.J.'s performance increased from 31 to 34. Additionally, her qualitative overall scores increased in all four of the tested areas, which suggest that her expressive and receptive communication has improved in these areas. Overall, W.J. was perceived to have excellent abilities in communicating her basic needs and daily planning, as well as good abilities in social communication and writing.

The rate of acquisition data of mastered targets are presented in Figure 5, and retention data of mastered, trained but not mastered, and untrained targets in each treatment block for W.J. are presented in Figures 6, 7, and 8, respectively. The number

Table 17

Summary of Communication Independence Scales of the ASHA FACS before and after treatment for Participant 2 (W.J.).

Communication Independence Scales	Pre-Treatment	Post-Treatment
Social Communication	6.3	6.7
Basic Needs Communication	7.0	7.0
Reading, Writing, Number Concepts	4.8	6.0
Daily Planning	6.2	6.8
OVERALL	6.1	6.6

Figure 5

Rate of acquisition of targets in each treatment block for W.J.

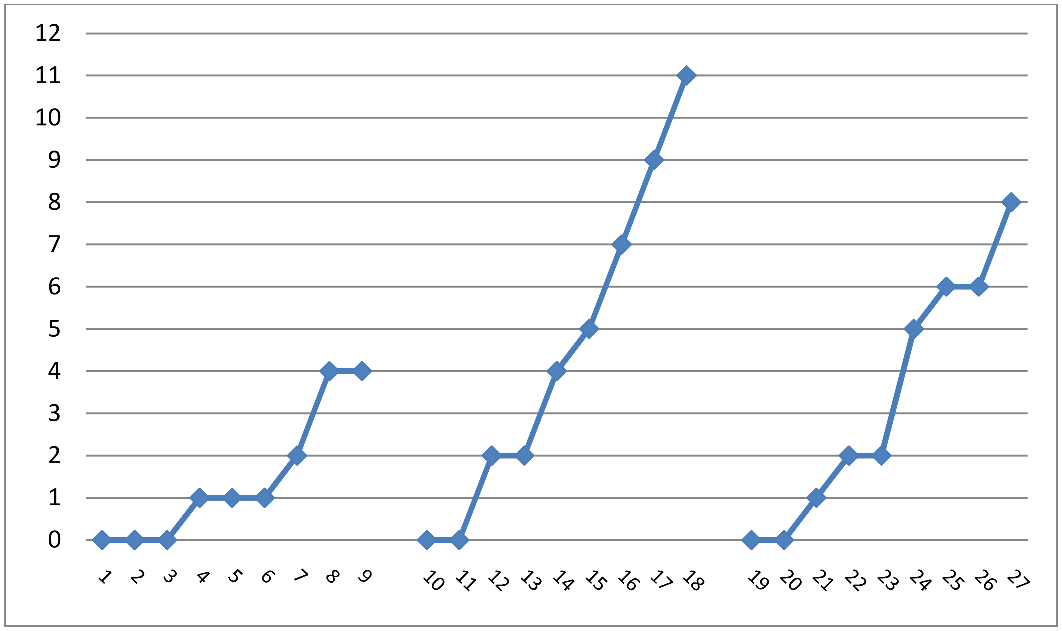


Figure 6

Retention rates of mastered targets at 3- and 6-weeks probes for all treatment blocks for W.J.

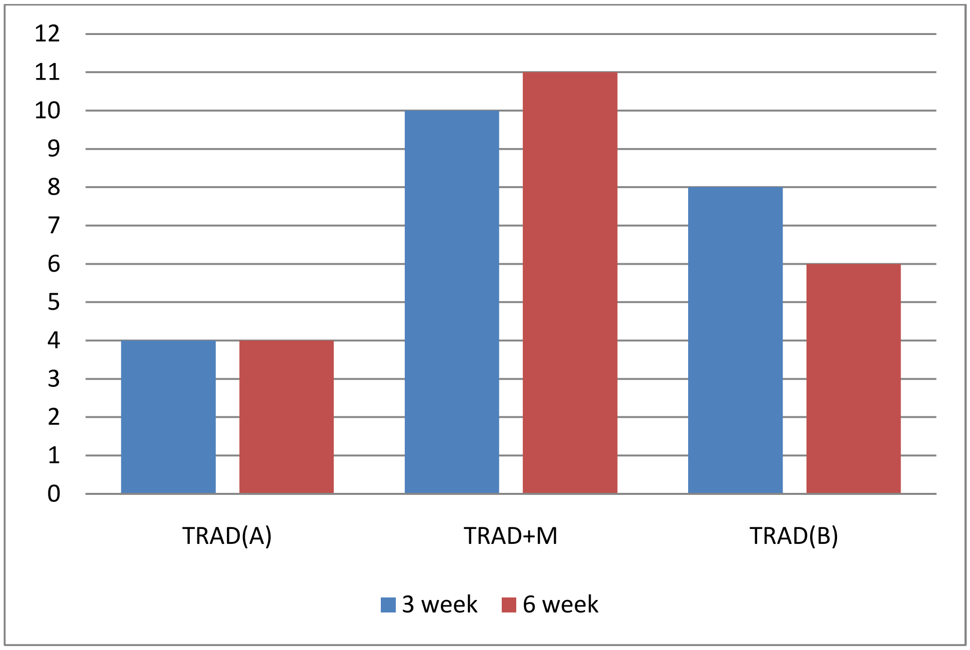


Figure 7

Retention rates of trained but not mastered targets at 3- and 6-weeks probes for all treatment blocks for W.J.

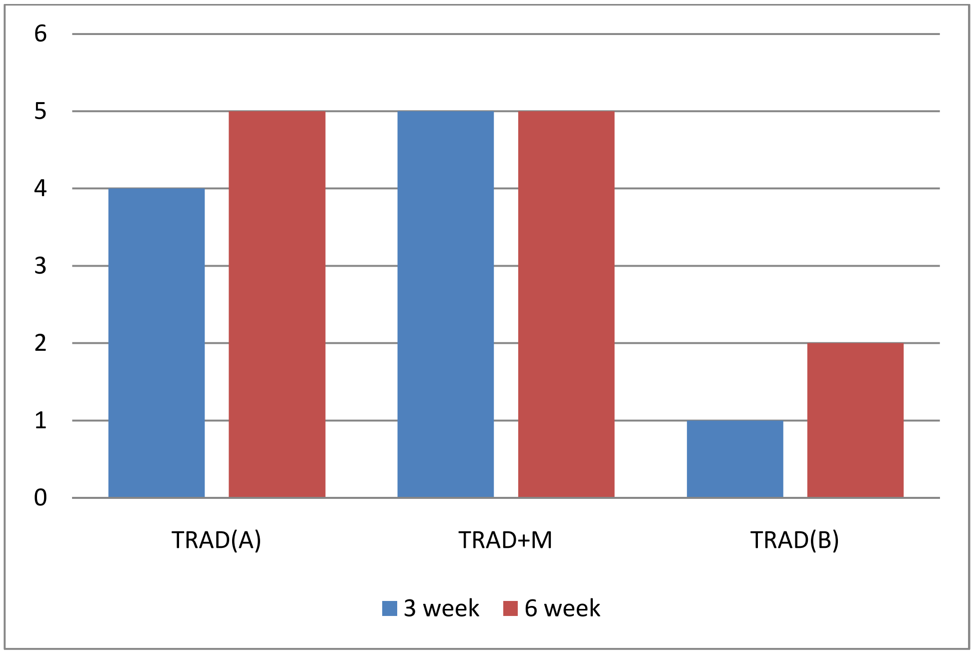
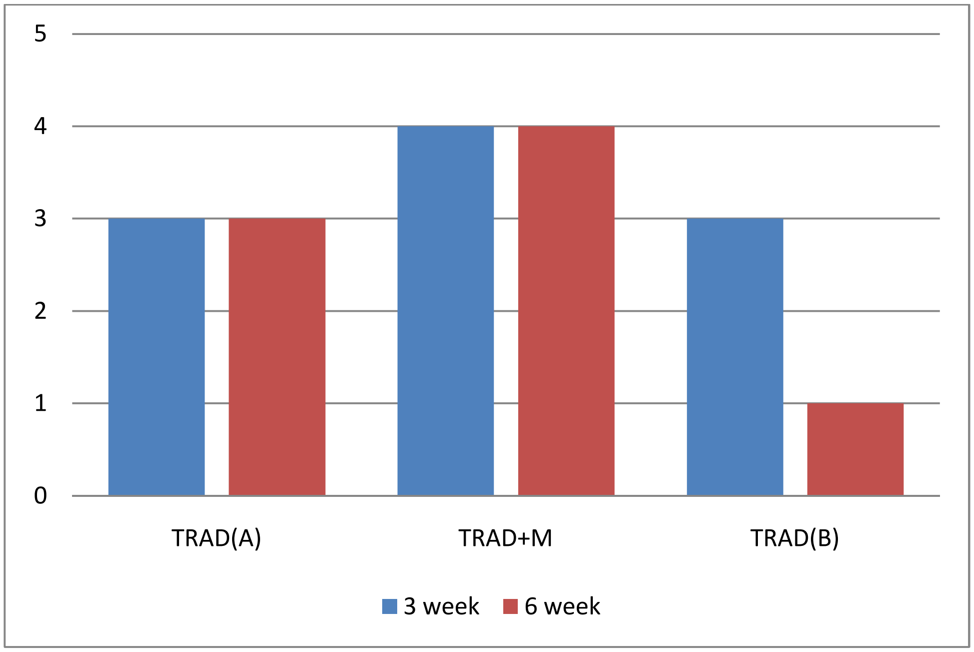


Figure 8

Generalization rates of untrained targets at 3- and 6-weeks probes for all treatment blocks for W.J.



of targets trained and mastered and number of trained, mastered, and untrained targets produced during 3- and 6-weeks probes for W.J. are presented in Table 18. During the initial TRAD treatment (i.e., TRAD(A1)), W.J. was trained on nine unique targets. She demonstrated mastery of four of these trained items (i.e., pipe, pie, pig, peach). The trained targets she was unable to master included: pants, pin, paintbrush, pizza, pan. During retention probes following each treatment block, W.J. was able to name four mastered targets at both the 3- and 6-week probes, respectively. Of the five items trained but not mastered during this treatment, she was able to name four and five of the targets at the 3- and 6-weeks probes, respectively. Of the 16 items selected for baselined for but not targeted during the TRAD(A1) treatment block, W.J. named 3 targets at the 3-week and 3 targets at the 6-week treatment probe. She was able to name the following untrained items at 3-weeks after the end of the TRAD(A1) treatment: pepper, puzzle, pencil. During the 6-week probe, she named the following untrained items: pepper, pear, popsicle.

During the TRAD+M block, W.J. was trained on 16 unique targets. She demonstrated mastery of 11 of these trained items (i.e., saw, sock, sun, seal, salt, sink, soap, singer, Santa, seatbelt, sailboat). The trained targets she was unable to master included: cereal, sandals, cell phone, saddle, safe. W.J. was able to name ten mastered targets at the 3-week and eleven mastered targets at the 6-week treatment probe. Of the sixteen items trained but not mastered during this treatment block, she was able to name five of the targets at both the 3- and 6-weeks probes. Of the nine items baselined for but not trained during the TRAD+M block, W.J. named four targets at the 3-week and four targets at the 6-week treatment probes. She was able to name the following untrained

Table 18

Number of targets mastered and trained but not mastered targets, and number of mastered, trained but not mastered, and untrained targets produced during 3- and 6-weeks probes for W.J.

	Number Mastered	Number Trained not Mastered		3-week Probe	6-week Probe
TRAD(A1)	4	5	Mastered	4	4
			Trained	4	5
			Untrained	3	3
TRAD+M	11	5	Mastered	10	11
			Trained	5	5
			Untrained	4	4
TRAD(A2)	8	5	Mastered	8	6
			Trained	1	2
			Untrained	3	1

items at 3-weeks after the end of the TRAD+M treatment: sack, seven, soup, and seesaw. During the 6-week probe, she named the following untrained items: seven, soup, seesaw, and sad.

During the TRAD(A2) block, W.J. was trained on thirteen unique targets. She demonstrated mastery of eight of these trained items (i.e., bird, banana, beard, bunny, bull, ballerina, baker, baseball). The trained targets she was unable to master included: belt, bicycle, backpack, baboon, bubblegum. W.J. was able to name eight and six mastered targets at the 3- and 6-week probes, respectively. Of the five items trained but not mastered during this treatment, she was able to name one and two of the targets at the 3- and 6-weeks probes, respectively. Of the 12 items selected baselined for but not trained during the TRAD(A2) block, W.J. named three targets at the 3- week and one target at the 6-week treatment probe. She was able to name the following untrained items at 3-weeks after the end of the TRAD(A2) treatment: bee, boat, bedroom. During the 6-week probe, she named bedroom.

These data suggest that, for this participant, both treatment approaches were successful in improving naming and speech production. The TRAD+M treatment approach was more successful in improving naming of trained targets as determined by the acquisition of trained targets; however, the retention of targets retained over time was relatively consistent across treatment blocks. W.J. mastered 4 targets during TRAD(A1), 11 targets during TRAD+M, and 8 targets during TRAD(A2). At both 3- and 6-weeks following the TRAD(A1) approach, she named 4 (i.e., 100%) of mastered treatment targets. Similarly, she named 10 (i.e., approximately 91%) of the 11 mastered items in the 3-week and 11 (i.e., 100%) of the 11 mastered items in the 6-week retention probe following the TRAD+M treatment block. Finally, she named 8 (i.e., 100%) of the mastered TRAD(A2) targets at 3-weeks after treatment and 6 (i.e., 75%) of the mastered TRAD(A2) targets at 6-weeks after treatment. Although she was dissuaded from doing so by the investigators, W.J. used her augmentative communication device to practice all of the target words at home to increase accuracy in naming and production. Due to the usage of additional practice outside of the treatment sessions, it is likely that this affected these retention data. However, it was determined that she used the AAC device throughout all three treatment blocks. Therefore, the effect of her using the device would have been consistent across all three treatments.

Generalization to untrained targets was remarkable for all treatment blocks. As was the case with the previous participant, visual inspection of the data would suggest that TRAD(A1) demonstrated the most generalization to untrained targets and TRAD+M demonstrated the least generalization. However, of the 16 targets untrained in TRAD(A1), W.J. was able to name approximately 19% of those targets at both the 3- and 6-week retention probes. She was able to name approximately 44% of the 9 untrained TRAD+M targets at both the 3- and 6-weeks, respectively. Finally, she named approximately 25% and 8% of the 12 untrained TRAD(A2) targets during the 3- and 6-week probes, respectively. This suggests that W.J. demonstrated relatively equal generalization to untrained items across treatment blocks, but the greatest percentage of untrained targets named was in the TRAD+M treatment block. Together, these data suggest that for W.J., the TRAD+M treatment protocol yielded the greatest outcome in terms of mastered targets; however, retention of targets and generalization to untrained targets following TRAD+M was similar to that of the TRAD treatment blocks.

CHAPTER 4

DISCUSSION

Conclusions and Implications

The purpose of this study was to compare two treatment protocols (i.e., traditional treatment and traditional treatment combined with music therapy) to improve expressive communication in persons with expressive aphasia and apraxia of speech. The current data are promising, and are consistent with previous research suggesting a positive treatment outcome when incorporating music therapy in the treatment of aphasia (Belin et al., 1996; Dworkin, Abkarian & Johns, 1988; Kennelly, Hamilton & Cross, 2001; Hundley & Drew, 2007). Both participants demonstrated improved speech and naming skills following both treatment approaches, and both participants demonstrated improvements on standardized assessments. Interestingly, both participants demonstrated the greatest treatment effects following the traditional treatment combined with music therapy. Further, both participants continued to show improvements in speech and naming after the music therapy was removed from the treatment protocol (i.e., TRAD(A2)).

Individually, F.V. demonstrated improved naming and speech production following all treatment blocks (i.e., TRAD(A1), TRAD+M, TRAD(A2)). She was most successful when utilizing the TRAD+M approach, demonstrating more mastered items and better retention of mastered, trained but not mastered, and untrained targets. Her performance on the BDAE-3 improved moderately on many tasks of auditory comprehension, oral expression, and reading; however, performance decreased on the writing subtest. She also demonstrated modest functional communication gains as indicated by the ASHA FACS completed by her mother following the final treatment session.

W.J. was more successful using the TRAD+M treatment approach in terms of number of items mastered; however, retention of mastered targets was consistent across the treatment blocks. This is likely associated with her use of the augmentative communication device to practice mastered targets at home. Her performance on the BDAE-3 suggested modest improvements on several subtests administered. Data obtained in the post-treatment administration of the ASHA FACS suggested that her husband perceived that her functional communication skills generally increased throughout the course of the study.

There are several implications that may be made from the results of this study. To begin, there was an extensive discrepancy between the number of mastered items between the TRAD(A1) treatment block and TRAD+M treatment block. This suggests that, for the two participants in this study, the conjoint use of music therapy and traditional therapy in the treatment of aphasia and AOS produced greater treatment outcomes than traditional approaches alone. Moreover, the treatment effects of the TRAD+M treatment did not completely recede when the music therapy portion was removed during TRAD(A2) treatment. When comparing TRAD(A1) treatment results and TRAD(A2) treatment results there is a remarkable difference in terms of the number of items mastered and retained. This could suggest that the initial use of music therapy along with traditional therapy might activate right hemisphere recruitment that would otherwise remain dormant during traditional therapy alone, and thereby cause subsequent traditional treatments to be more successful.

Another implication of this study is the evidence of retention of targets over time. Both of the participants demonstrated a remarkable retention of mastered targets when probed at 3- and 6-weeks following each treatment block. F.V. demonstrated greater retention of mastered targets following the TRAD+M treatment approach compared to either TRAD(A1) or TRAD(A2), whereas W.J. revealed remarkably less variation in retention. Interestingly, when comparing TRAD(A1) and TRAD(A2) data for both participants, there is a difference in the number of items retained for F.V., with TRAD(A2) being remarkably higher. W.J.'s retention data were again relatively consistent across these treatment blocks. W.J.'s performance was most likely associated with her use of an AAC device to practice targets at home. In all, these data suggest that retention of mastered targets is positive following all treatment approaches utilized in this study, and that, for some participants, the addition of music therapy to the treatment protocol may result in greater retention of mastered targets.

Finally, both of the participants demonstrated generalization to untrained targets following each treatment block. As previously discussed, visual inspection of generalization data would suggest that TRAD(A1) resulted in the greatest amount of generalization, and TRAD+M the least. However, of the 15 targets untrained in TRAD(A1), F.V. was able to name approximately 53% and 40% of those targets at the 3- and 6-week retention probes. She was able to name 100% of the four untrained TRAD+M targets. W.J. named remarkably more (i.e., 19% in TRAD(A1) and 44% in TRAD+M) targets at both the 3- and 6-week retention probes. This suggests that both participants demonstrated relatively equal generalization to untrained items across treatment blocks, but the greatest percentage of untrained targets named was in the TRAD+M treatment block. These data suggest that incorporating music therapy into the traditional speech and language treatment protocol may result in greater generalization to untrained items compared to traditional approaches alone.

All together, these data are promising. They reveal great potential in using music therapy in conjunction with traditional treatment approaches of aphasia and AOS to improve speech and language function in chronic aphasia and AOS. For these participants, mastery of items, retention of mastered items, and generalization to untrained items was best when music therapy was added to the treatment protocol. Further, the effects of utilizing this music approach for a short time appeared to positively influence the outcome of the traditional approaches when music therapy was removed.

Limitations of the Present Study

Due to the design of the present study, it cannot be determined which treatment approach most significantly led to the positive outcome observed in both participants. Regardless of this, it should be noted that language measures administered to these participants revealed positive outcomes following this study. This suggests that the utilization of traditional approaches with the addition of music therapy appears to be beneficial in the treatment of aphasia and AOS. In addition to the improved performance on the BDAE-3 and the ASHA-FACS, the results revealed a substantial difference in the number of mastered treatment targets between the TRAD(A1) and TRAD+M approaches for both of the participants. This further supports that the use of music therapy in the treatment of aphasia and AOS produces greater treatment outcomes than traditional approaches alone.

Apart from the treatment effects associated with the design of the treatment, it is possible that other variables may have led to the positive outcome observed in this study. For example, these results may be due to the intensive therapy each participant received. It has been documented in the literature that greater treatment outcome is observed in participants who received intensive therapy compared with those who received less frequent intervention (Basso & Caporali, 2001). With the exception of F.V. who missed one treatment session during the TRAD+M treatment, each participant received 4.5 hours of therapy each week for nine weeks. This totals 36 and 40.5 hours of treatment for F.V. and W.J. over 9 weeks, respectively, which could be considered intensive treatment. It is possible that the treatment effects observed here are related to the frequency of treatment rather than the treatment approach itself. However, the authors suggest that the difference between TRAD(A1), TRAD+M, and TRAD(A2) in terms of mastery, retention, and generalization would not be so dramatic if this were the case.

In addition to the intensity of treatment, it is possible that the order in which the treatment approaches were administered may be associated with the outcome. This is a limitation of the study, and additional participants are necessary to determine what effect order has on outcome, if any.

Further, the extent to which a participant enjoys music and singing or has musical training may also affect results. In this case, both participants enjoyed music, and one, W.J., had participated in her church choir prior to her stroke. It is possible that incorporating music would only be appropriate and beneficial for those who have, at least, an appreciation of music. When possible, participants with less interest in music therapy and those without training should be administered this approach to assess the impact these factors have on outcome.

Finally, the following phonemes were selected for each of the TRAD(A1), TRAD+M, and TRAD(A2) treatments, respectively: /p/, /s/, and /b/. It can be seen that these are not equally balanced for manner, place, and voicing. The /p/ and /b/ phonemes are cognate pairs, meaning that they differ in only one of the three articulation production features: place, manner, and voicing. In this case, /p/ and /b/ are produced using exactly the same place (bilabial) and manner (plosive), with the only difference being that /p/ is voiceless and /b/ is voiced. As a result, it could be argued that the /b/ phoneme targeted in the TRAD(A2) approach was already primed by the use of the /p/ in TRAD(A1). It is possible that is the reason for the greater mastery of targets observed in TRAD(A2) compared to TRAD (A). Further, it could be argued that because /p/ and /b/ are among the first phonemes learned in typical development, they are retained in post-stroke brains in a manner similar to nursery rhymes, thereby making them easier to produce in speech and language tasks.

In addition to this, the /s/ phoneme is very different from the /p/ and /b/ phonemes. The /s/ phoneme is an alveolar fricative that shares only one feature with the /p/ phoneme (i.e., voicing) and no features with the /b/ phoneme. It could be argued that, because /s/ is very different from /p/ and /b/, which are very similar, using /s/ made the traditional therapy portion of TRAD+M more difficult than TRAD(A1) and TRAD(A2), thereby causing the participants to rely more heavily upon the music therapy portion of TRAD+M, thus triggering greater right hemisphere recruitment . Ideally, future studies should balance all phonemes involved by making each one different only by the same number and type of features.

Directions for Future Study

The current data are very promising; however, additional research is still necessary. The participants in this study were similar in age, gender, age of onset, time post-onset, prior speech therapy, and type and severity of aphasia with concomitant AOS. Future studies should incorporate participants that vary in all of these degrees. It has yet to be determined how this treatment would work for someone with milder, or more severe aphasia, or aphasia of a different type. Furthermore, this study had only two participants, which is insufficient to suggest that this protocol would work for other individuals with aphasia. Therefore, future studies should include more participants. As previously discussed, the limitations identified in the current project should be corrected in future studies to clarify data and improve conclusions.

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EFFICACY OF USING MUSIC THERAPY COMBINED WITH TRADITIONAL APHASIA AND APRAXIA OF SPEECH TREATMENTS

By

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Committee:

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