Behaviorally-oriented intensive aphasia program: Collaboration leads to optimal outcomes

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Abstract

Background: Aphasia is an acquired disorder most often due to a stroke or brain injury; it can affect all language components of the brain across modalities. It has been established that intensive therapeutic interventions for symptoms of aphasia are effective; however, the specific approaches and teaching methods are not well defined. The purpose of the current study was to examine the efficacy of a behaviorally-oriented intensive communication therapy for aphasia (BICA) approach designed by a Speech-Language Pathologist (second author) and a Board Certified Behavior Analyst (first author) for a 71-year old woman with post-stroke aphasia. *Method*: Using a case study design, the participant was provided with 12 hours/week of treatment for 12 weeks. Treatment focused on functional communication goals using a behavioral interpretation of language and stimulus control transfer procedures. The behavior analyst determined conceptually systematic interventions based on targets selected by the speech-language pathologist in consultation with the participant. *Results:* The participant demonstrated substantial improvements in written language expression and comprehension, reading fluency, oral language expression, naming, and improved quality of life. *Implications:* Individuals with aphasia can make substantial gains in oral and written language post-stroke with a collaborative, systematic, intensive approach.

KEYWORDS

aphasia, collaboration, intensive, language, verbal behavior

Learning Outcomes:

After reading this article, the learner will be able to:

- Describe how SLPs and BCBAs can collaborate in aphasia treatment
- Contrast a linguistic vs. behavioral interpretation of aphasia
- Define the 6 verbal operants used in the behavioral interpretation of aphasia

Disclosures

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BACKGROUND

In Canada, stroke is the leading cause of adult disability[1], and 1 in 3 Canadians will develop stroke, dementia, or both.[2] Aphasia is a communication impairment that can affect all language components (ie, phonology, morphology, syntax, semantics, and pragmatics) across modalities (ie, speaking, reading, writing, and listening). Research has shown that 1 in every 3 stroke survivors has symptoms of aphasia.[3,4,5] Though aphasia is more common than Parkinson's disease, cerebral palsy, and multiple sclerosis, most people are not aware of aphasia and the significant impact it has on a person's quality of life. In fact, research shows that only about 5% of the population understands aphasia.[6] Aphasia robs a person of the ability to convey feelings of pain, hunger, sadness, ask for their wants, needs, and share their desires. Others may assume that the person is not competent or simply has nothing to say. Without the ability to communicate, the person with aphasia is left isolated, often dependent on others, depressed, and quality of life is significantly impacted. All individuals impacted by aphasia deserve access to communication opportunities. Improvements in communication skills have been shown to lower frustration and depression for individuals post-stroke and decrease caregiver burnout.[7] Therefore, there is a need to address these specific deficits in therapy to improve the quality of life for the individual and their communication partners.

In aphasia treatment, there are a number of therapy pathways an individual can take to address speech and language concerns: community aphasia programs, 1:1 speech-language therapy, and intensive aphasia programs, each with unique benefits to the client. In regions where a community aphasia program is available, individuals have the opportunity to engage in functional conversation with fellow stroke survivors. Communication and discussion are facilitated by professionals trained in supportive conversation strategies with a focus on

providing communication opportunities and encouraging multiple modes of responding to convey a message. Though these maintenance programs are integral in aiding post-stroke individuals to reintegrate into their community and build a support network, they are not sufficient to reduce the symptoms of aphasia.

Some individuals may receive direct one-to-one therapy with a Speech-Language Pathologist to work on improving speech and language skills, either in the hospital, outpatient rehabilitation programs, funded therapy in the community, or private practice. Limitations to direct therapy include access and eligibility (ie, may require individuals to need at least two different types of rehabilitation to qualify for services), length of stay, and finances. The Canadian Stroke Best Practice Recommendations[8] states that individuals with aphasia should be given the opportunity to have intensive speech, language, and communication therapy soon after their stroke, according to their goals, needs, and level of impairment, yet these programs are not readily available in many areas. With only approximately 18 intensive aphasia programs worldwide, many people with aphasia are not able to access an intensive therapy program.

A review on the intensity of aphasia therapy and resulting impacts on recovery highlighted that speech therapy alone (ie, 2 hours per week) provided no additional functional language recovery than what could be achieved with spontaneous recovery.[9] In a recent Cochrane Review, Brady et al.[10] reported that functional communication was significantly better following intensive treatment for some individuals than those who received therapy at a lower intensity. On average, Speech-Language Pathologists provided 1 to 5 hours of treatment per week, and research showed that this level of intensity is not sufficient.[11] In fact, in order to make significant gains beyond spontaneous recovery, it is likely that at least double this intensity is required.[11] Bhogal et al.[9] concluded that 2-3 months of intensive aphasia therapy was fundamental to

maximizing an individual's recovery, and without such intensive therapy, an individual's outcomes may be compromised. An intensive, comprehensive aphasia program that provides 5-10 hours per week of intervention over an 8-12 week period showed strong treatment effects as opposed to a program that provided 2-4 hours per week for 20-26 weeks.[9] Research has demonstrated that short periods of intensive therapy for post-stroke aphasia can be very effective in improving communication abilities.[12,13] Luccese and colleagues[14] found that highly intensive speech therapy (ie, 10.5 hours/week for 4 weeks) resulted in language improvements.

An intensive aphasia program involves mass practice, repetition, and applies principles of neural plasticity, which suggest that this high-intensity practice is an essential component for learning after brain injury.[15] In their survey of international practice of intensive aphasia programs, Rose et al.,[15] suggest that an intensive aphasia program should directly target domains of the International Classification of Functioning, Disability, and Health (ICF)[16] including reduced participation in conversations, reduced involvement in one's community, impairments in language, as well as personal and environmental factors. Intensive programs should take a holistic approach targeting a combination of impairment-based, function-based, and activity-based skills,[15] and incorporate the client's needs and values. The optimal dose, frequency, form, and duration are yet to be defined due to the disparity in research methodologies.[17] The intensive model poses a barrier for individuals living with aphasia as this recommended treatment intensity is often not financially feasible, nor is it available through public health systems and most private clinics. The lack of intensive treatment options poses a risk for individuals with aphasia who want to return to work and live an independent life. Of the existing programs, the majority look to the traditional, medical model of speech pathology to guide the treatment. With interprofessional practice being the recommended and accepted

standard of care following a stroke,[18] intensive aphasia programs would also benefit from strengths of other professions.

INTERPROFESSIONAL COLLABORATION

Interprofessionalism is a process undertaken by professionals from different disciplines who establish a foundation of shared values, ethics, standards, and effectively engage in collaborative practice.[19] Interprofessional collaboration has been associated with a number of benefits for clients and care providers, including enhanced quality of care, improved client health outcomes, improved work-life of health professionals, stronger partnerships between professionals and their clients, and optimized cost of health care.[20]

The traditional model for aphasia rehabilitation includes speech therapy at the forefront: Speech-Language Pathologists (SLP) have training, skills, and competencies in assessing and treating individuals with aphasia. The SLP can make recommendations for treatment utilizing dynamic assessment, integrating the client's values, and using the best practice recommendations for aphasia treatment. Most SLPs do not have experience treating in an intensive model, and the research in intensive SLP rehabilitation is not conclusive or prescriptive. Incorporating other professionals and interprofessional practice into the intensive aphasia model has the potential to strengthen the experience for the client and the professionals involved.

Board Certified Behavior Analysts (BCBAs) often have extensive experience in intensive, comprehensive therapy services with a focus on working across many domains simultaneously. Applied Behavior Analysis (ABA) is focused on using learning theory to improve the human condition, which can be applied to many populations, including treating those with aphasia. ABA therapy has been shown to be an effective treatment for autism which has led to an incorrect assumption that it is synonymous with autism therapy. While much of the

knowledge base of behavior analysts has focused on the treatment of children with autism, the basis of ABA is focused on using learning theory to improve the human condition, which can be applied to many populations, including treating those with aphasia.

Aphasia, as a disorder, is rather idiosyncratic in its presentation requiring an individualized process in determining goals and teaching procedures. Many current SLP practices incorporate behavioral practices including the use of single-subject analysis, antecedent manipulations through prompting and modeling, prompt fading through systematic procedures like Copy and Recall Treatment (CART) or Melodic Intonation Therapy (MIT) and could benefit from further collaboration. Behavior analysts are trained on the single case study design, which can be useful when treating such conditions and evaluating outcomes. BCBAs can add value to interdisciplinary teams because they focus on measurement, accountability, and evidence-based treatments. BCBAs are skilled in creating objective and measurable goals, developing and implementing data collection and graphing procedures, and monitoring treatment fidelity. Behavior analysts can administer and analyze data from the therapeutic assessment process, aid in developing individualized skill acquisition programs, and help determine teaching approaches related to language function (ie, use of verbal operants). Both SLPs and BCBAs target socially significant behaviours and functional outcomes.

There is overlap in areas of competency between SLPs and Board Certified Behavior Analysts (BCBAs) (ie, both professionals are trained to assess and treat receptive and expressive language deficits) and diverse areas of strength. In some settings, SLPs and BCBAs can be at odds with each other, likely over misunderstandings of the respective scopes of practice, incorrect stereotypes of each discipline, and a misperception of encroachment.[21] The success of interprofessional collaboration involves establishing a foundation of shared values, creating an

"inclusive" team culture,[20] while using the strengths of both professions to design a treatment program that is effective and founded on the best available research.

BEHAVIORAL INTERPRETATION OF APHASIA

Traditionally, Speech-Language Pathologists describe the individual's deficits as oral or written language and expression or understanding. Using the expressive/receptive dichotomy to assess and treat aphasia symptoms may not account for all of the person's unique linguistic profile. For individuals with aphasia, it is often not the entire receptive or expressive repertoire that is impacted, which cannot be accounted for using a linguistic approach alone.[22] For example, the person cannot say the name of an item such as "ball" when presented with the item but can say the name "ball" when given a definition,[22] which are both examples of an expressive naming task. In the first example, the response is provided because of visual stimuli in the environment (ie, seeing a ball), whereas in the latter example the response is provided as a result of the verbal behavior of another person (ie hearing the verbal definition). Understanding the functions of language can provide valuable information about an individual's strengths and can inform training procedures to target unique skill deficits. Skinner's[23] *Verbal Behavior* proposed an approach to language based on its function and has been widely adopted in the developmental disabilities population.[24-27] This approach is underused in the rehabilitation of language for adults with acquired communication disorders despite their being potential benefits to using this approach with heterogeneous conditions such as aphasia.[22,28,29] Skinner[23] provided an analysis of verbal behavior and aphasia, suggesting that individuals with aphasia may have lost some of the functional relationships that control certain responses (eg, an individual can label an item but cannot request it). Therefore, the loss of functional relationships in aphasia may be due to the brain injury that is affecting specific classes of stimulus-response relations.

The verbal operants were first defined by Skinner[23] as a way of defining language based on its function. Units of language are influenced by their environment, and each is defined based on the antecedents and consequences that occasion and maintain them instead of focusing on the grammatical structure and form.[22] Skinner[23] defined 7 verbal operants: echoics, transcription, textual, mands, tacts, intraverbals, and autoclitics. He defined echoics as imitating a spoken word (eg, saying "ball" after hearing the word "ball") where the antecedent is hearing the spoken word and the consequence is typically a positive socially mediated response from someone else.[23] Transcription is defined as writing a word that you have heard (eg, hearing the word "ball" and writing b-a-l-l) and textual refers to seeing a written word and reading it aloud (eg, reading the word "ball" out loud).[23] Echoics, transcription, and textual responses tend to be easier to emit and thus have a simpler minimal repertoire and tend to survive longer post-stroke.[22] Mand refers to the language used to obtain something desired (eg, asking for a ball) where the antecedent is a specific motivative operation (e.g. deprivation, aversive stimuli, etc.) and the consequence is obtaining the item, action, information, etc.[23] Tact refers to labeling an item (eg, seeing a ball and saying "ball") and is occasioned by a nonverbal stimulus, and the consequence is a social response from the listener.[23] Intraverbal refers to responding to the spoken language of someone else (eg, saying "ball" after someone says "it's something you throw") whereby the antecedent is the verbal behavior of someone else and the consequence is a social response from another person.[23] Mands, tacts, and intraverbals have a more complex minimal repertoire and thus tend to be more severely impacted post-stroke.[22]

To further define language according to the stimulus-response relationship, Haughton[30] created a learning channel matrix that focused on the stimulus input (ie, see, hear, or touch) and response output (ie, say, write, or point). For example, a person with aphasia might see a book

and say “book,” which would classify as a see-say tact. Though saying the word “book” may come easily, that same person may not be able to write the word “book” given a verbal cue (a hear-write transcription) or say the word book when asked, “what is something you read?” (a hear-say intraverbal).[22] This framework is useful for assessing an individual’s expressive and receptive communication but is also useful when defining precise targets for treatment and developing prompting strategies. The verbal operants provide a framework to more precisely define language and identify impairments compared with the traditional topographical approach.

Topographical classifications of language deficits can be useful when describing language impairments but pose challenges in creating an intervention strategy.[22,31] Baker et al.[22] offered a behavioral interpretation of aphasia that focused on observed deficits and treatment using verbal operants, which switched the focus of intervention to the function of language instead of simply the topography. Further, a behavioral interpretation of aphasia focused on observed deficits and treatments to remedy those deficits as an alternative to the traditional approach, where the type of aphasia was directly related or named for the damaged area of the brain.[32] A functional approach to language allows clinicians to describe areas of strengths and deficits precisely enabling them to develop individualized, effective treatment programs for individuals with heterogeneous conditions like aphasia. When conducting an assessment, it is important to not only document incorrect responses to assessment tasks but also examine the speaker-listener environment (antecedent-consequent variables) in which the error occurred.[31] If we omit this from an assessment, a critical part of the individual’s language profile is missing.

By assessing a skill across verbal operants, clinicians are able to identify which operants are intact (strong) and which operants are impaired (weak) and determine appropriate prompts and teaching strategies. In an overview of cueing hierarchies, Patterson[33] highlighted the

importance of utilizing prompts that are: appropriate for the individual's specific impairment (ie, anomia), used in an order most likely to elicit an appropriate response, and combined with carefully selected targets. As such, it seems pertinent to suggest that an individualized assessment based on the verbal operants be conducted prior to treatment to determine which strategy may be the most effective for that individual rather than applying a prompting hierarchy indiscriminately across clients.

Sidman[34] described aphasia as a "fracturing of stimulus control" meaning that there is a breakdown between the antecedent stimuli that is meant to occasion the response and the person with aphasia's response repertoire.[35,36] For example, an individual with aphasia may be able to point to a named item (e.g. an apple) when presented with an array of pictures but is unable to say the word "apple" when asked to name the picture. In the first example, the stimulus-response relation is intact (ie, identifying a picture of an apple in an array) while in the second it is fractured (ie, saying the word, "apple"). Stimulus control transfer procedures come from the behavior literature and refer to using prompt fading and prompt delay techniques to improve an individual's skills.[34] In stimulus control transfer procedures, a strong verbal operant is used as a prompt for a weaker verbal operant which is systematically faded over time. In rehabilitation therapy for individuals with aphasia, this means assessing the skill across verbal operants prior to teaching to determine which operants are strong and which operants are weak (to be addressed in teaching). Once this information has been gathered, an individualized prompting strategy can be created and can guide the clinician in selecting the right approach to treatment.

A recent paper by Ritchie et al.[37] examined the clinical utility of a functional approach to language assessments for individuals with aphasia. In this study, two stimulus control transfer procedure methods were compared. A functional approach to defining and assessing language

was shown to be effective and useful. Other studies focused on the rehabilitation of language for older adults support similar findings, a functional approach to language is effective, useful and enables clinicians to create an individualized intervention strategy.[37-40] Mozzoni[41] stated that ABA's emphasis on operational definitions, single-case designs, and ability to be incorporated into other disciplines is valuable when evaluating rehabilitation outcomes.

Overall, a behavioral interpretation of aphasia using the verbal operants[22] involves defining language based on the antecedents that precede it and the consequences that maintain it, addressing observable deficits in treatment, and the use of stimulus control transfer procedures in teaching. Skinner's analysis of verbal behavior provides a framework for understanding human language, the primary focus has been on populations that have never had an extensive verbal repertoire (eg, autism), recent research indicates there is a utility for this framework in rehabilitation efforts with those had intact repertoires that have been impacted due to trauma or aging such as in adult rehabilitation.

In the current study, an adult woman with aphasia participated in a novel behaviorally-oriented intensive communication therapy for aphasia (BICA) program. Through interprofessional collaboration, the program was able to integrate a linguistic model that is based on topography with a verbal operants' model based on functionality to identify specific deficits, develop meaningful goals for the individual, and create dynamic teaching programs.

The research questions were as follows:

1. Will the BICA approach result in improved functional communication abilities in the participant?
2. Will the BICA approach result in improved naming abilities in the participant?

3. Will the targeted direct instruction result in improved reading skills in the participant?
4. Will the targeted intervention result in improved quality of life in the participant?

It was expected that intensive, targeted instruction that focused on improving functional language abilities, in addition to reading and writing instruction, would improve the participant's quality of life, as predicted by the theoretical and empirical soundness in the reviewed research above on intensive aphasia treatment, supported by the behavioral interpretation of aphasia.[22]

METHODS

Program Overview

The BICA program targeted the participant's language impairments, participation/functional language skills, education in Supported Conversation for Adults with Aphasia (SCA™)[42] for the participant, her family, and communication partners, and used a variety of delivery approaches (ie, 1:1 treatment with multiple instructors across a variety of clinical and functional settings, including the use of technology and homework). The program consisted of 12-13 hours of training per week. Instruction was provided by the SLP (second author) (2-3 hours per week) and Registered Behavior Technicians (RBT®) (10 hours per week), who were supervised by the BCBA (first author). See Table 1 for the treatment schedule.

The total time of the intensive program was 12 weeks. The first week consisted of baseline measures, and the final week was used for post-test measures resulting in 10 weeks of treatment. Treatment for the participant included individual therapy completed at a therapeutic clinic, monthly team meetings, and caregiver training conducted at the end of treatment. Treatment was designed with the following elements: defining language using the verbal

operants, stimulus control transfer procedures, reinforcement, ongoing data analysis and interpretation, and precision teaching techniques.

Interprofessional Collaboration

The program involved collaboration between the participant, an SLP, a BCBA, and two Registered Behavior Technicians (RBT) (see Table 2), and all clinicians involved in the program were trained in SCA™.[42] The SLP utilized a dynamic assessment approach[43] which involved interviewing the participant and her family, conducting diagnostic and standardized assessments to guide a collaborative goal-setting process, and ongoing discussion of the results with the participant. The SLP interviewed the participant and her support person to understand her individual needs and to establish treatment goals. The SLP incorporated the client's perspective on priorities for improving functional language skills (eg, selecting a goal to successfully retrieve information from a voicemail) and interpreting her performance on standardized assessments (ie, improving reading comprehension was identified as an area of weakness in testing and was also a priority for the client). The BCBA conducted baseline and post-test assessments for individual treatment goals determined by the SLP, developed conceptually systematic treatment protocols for goals identified by the SLP, including data collection and prompting procedures, supervised the RBTs, and conducted ongoing data analysis. The participant was involved in selecting appropriate functional goals and themes for language targets (ie, targets were selected based on the client's interests, needs, education, and background).

Participant

The participant was a 71-year old caucasian, monolingual woman with aphasia post left-hemisphere CVA in 2017 (Claire; name changed to maintain client confidentiality). Claire contacted the private clinic where treatment was provided to inquire about participating in an

intensive aphasia program. Claire had previously received individual 1:1 speech therapy for more than one year and had participated regularly in weekly community aphasia programs. Claire sought out an intensive aphasia program to address specific communication challenges that continued to negatively impact her daily life. Before retiring, she was a highly motivated and driven individual who had a busy career as an Acute/Critical Care Nurse (CCRN) and clinical research associate. Claire was proudly independent and lived alone, though her immediate family members were actively involved in her life. She also had a supportive partner who assisted the participant in articulating her unique challenges and was involved in selecting functional treatment goals. Claire was 2 years post-stroke when she attended the intensive program.

Setting

The participant attended the treatment clinic 3 days per week for therapy sessions. Sessions were held at approximately the same time each day, and if a session needed to be skipped due to an appointment, holiday, etc., attempts were made to reschedule that session. Sessions included 10 hours per week of 1:1 therapy implemented by RBTs and two 1-hour sessions per week with an SLP. Early in the program, at the participant's request, SLP therapy was increased to two 1.5-hour sessions per week.

All testing and sessions occurred at a private clinic. The treatment room consisted of a table and chairs with limited to no background noise; for generalization, the clinician added background noise via an iPad app. Treatment also occurred in the natural environment for at least 1 hour every week, such as inside a coffee shop or a grocery store.

Assessment Measures

Claire was assessed using a number of standardized and informal measures before treatment to determine her strengths, challenges, and goals for the program. The SLP

administered the Western Aphasia Battery-Revised (WAB-R),[44] and Claire was found to have 'mild' aphasia (WAB-R[44] Aphasia Quotient = 85.5, whereas an AQ + 75 is considered mild). In conversation, Claire struggled with anomia, circumlocution, and had difficulty providing clear and concise verbal narratives and giving instructions. She used phonological (ie, "bastry" for *pastry*), semantic ("mom" for *daughter*), and neologistic paraphasias (ie, "igit" for the word *describe*) in conversation.[45] Claire demonstrated limited awareness of her errors (ie, she was aware of errors 58% of the time pre-treatment in a 1-hour conversation sample). When Claire was aware of her errors, she would either: self-correct (ie, saying, "*Pitsdelia... No, that's not right, it's Pittsburg*"), repeat variations of the word multiple times until she arrived at the correct word (ie, saying "*line… lane... plane... no, it's a runway!*"), or say the word with a questioning intonation (ie, "*Harrison? No, Harrisburg.*"). When she was unaware of her errors, she would use the paraphasia in a sentence and not attempt to repair, clarify, or request assistance.

Claire demonstrated strengths in her single word receptive vocabulary, assessed using the Peabody Picture Vocabulary Test, 5th Edition (PPVT-5).[46] Claire achieved a standard score of 109 (CI 105-113, where average scores fall between 85-115) on the PPVT-5, demonstrating a high-average understanding of single words. The SLP assessed Claire's expressive vocabulary using the Expressive Vocabulary Test, 3rd Edition.[47] Claire's receptive vocabulary was significantly greater than her expressive vocabulary (EVT-3 Standard score 77, where average scores fall between 85-115, compared to PPVT-5 Standard score 109, significant difference 0.05). The PPVT-5 and EVT-3 were used for three reasons: first, the test includes a broad range of vocabulary and therefore can be used to measure the degree of aphasia and vocabulary impairment in adults,[48] second, the EVT-3 is co-normed with the PPVT-5 and allows for direct comparisons between expressive and receptive vocabulary knowledge, and third, the tests have

parallel test forms with similar content and design but unique items that allow for repeated administration to monitor progress without using the same stimuli.[47]

Most individuals have a greater understanding of words compared to the vocabulary they actually use; for example, you may know that the word "iridescent" has to do with light but do not have an occasion to use it when speaking or writing.[47] For Claire, her understanding of words was significantly higher than her ability to label words, likely due to her word-finding difficulties. In terms of her written language skills, Claire could write single words but struggled to generate a grammatically correct written sentence containing a subject, verb, and object (ie, she achieved 0% at pretest to write a complete sentence using an SVO structure). She also had difficulty understanding written language; she was given a 6th-grade reading passage on the Qualitative Reading Inventory (QRI-6)[49] and answered comprehension questions at a "frustration" level.

In addition to the Aphasia Battery (WAB-R),[44] receptive (PPVT-5)[46] and expressive (EVT-3)[47] language assessments administered prior to treatment, the SLP administered additional diagnostic assessment tools such as the Mount Wilga High Level Language Test[50] and the aphasia domain on the Assessment for Living with Aphasia (ALA)[51] ~~to the participant~~ to better understand the participant's strengths, challenges, and to inform areas of focus for treatment.

Experimental Design

Claire provided informed verbal and written consent to participate in the intensive aphasia program. The assessments and intervention sessions were part of her regular treatment program. Claire provided informed consent for the authors to present her information, goals, and progress in this paper. Dynamic assessment[43] was utilized throughout treatment, whereby decisions made by the BCBA and the SLP on changes to the intervention depended on what the

data showed each day about the effects of the current intervention. Variations to specific interventions were primarily made to the type of prompts provided to aid the participant in the task. Prompts were consistently applied across sessions and faded as progress was made. If the participant's performance in a task deteriorated across 2 sessions, the prompt level was increased.

Treatment fidelity checks and interobserver agreements were taken during regularly scheduled observations by the SLP or BCBA (minimum of 10% of total participant hours). The main dependent variable in all tasks was a number of correct responses out of 10 opportunities or a total number of correct responses in a one-minute timing. Responses were scored as correct or incorrect; if no response was given within 15 seconds the trial was marked as incorrect.

The independent variables used throughout the program consisted of the following: (1) giving standardized instructions about a task and target behaviors in each task (2) setting the occasion for the target skill to occur (ie, asking a question, showing a picture, etc.) and waiting the allotted amount of time for a response, (3) providing prompts and models to increase success with a given target and to fade these out systematically using stimulus control transfer procedures (4) correcting errors through rehearsal (5) reinforcing correct responses through positive remarks and visual performance feedback through data graphing.

Teaching Procedures

Once a target skill was selected for intervention by the SLP (through dynamic assessment and interview with the participant), the BCBA baselined the skill across verbal operants (e.g. labeling numbers, repeating strings of numbers, identifying numbers receptively, etc.) to determine the strengths and weaknesses of the individual. For example, Claire wanted to be able to write down a date after it was told to her (eg, for an appointment). Prior to treatment, the

BCBA probed Claire's ability to: read a date that was written on a piece of paper (see-say textual), repeat a date told to her (hear-say echoic), and write down the date when told orally (hear-write transcription). After gathering this data, the BCBA determined that Claire could complete the see-say textual task with ease but struggled with echoic and transcription trials (see Figure 1). This information was used to increase her ability to transcribe a date using stimulus control transfer procedures.

Baseline measures of all dependent variables were completed prior to implementing an intervention (see Figure 2). During baseline testing, the participant was provided with 10 opportunities to exhibit the skill and scored as correct or incorrect. No prompts or performance feedback were provided during baseline measures. The same measures (with different stimuli) were completed at the end of treatment to assess treatment effects.

Once baseline data was obtained and the teaching procedure was written, the BCBA and SLP would train the RBTs on how to implement the program. Then, the RBTs would implement the program daily with the participant. Data analysis was conducted weekly by the BCBA (unless flagged sooner) to assess the effectiveness of the teaching procedure. Dynamic assessment was evident in the continuous interaction between assessment, therapy, and data used to inform teaching procedures. Once a goal was considered mastered (ie, over 90% for 3 consecutive days), maintenance and generalization efforts were completed whereby goals were practiced less frequently and conducted with more naturalistic conditions (such as in a grocery store with background noise).

Treatment Goals

An individualized treatment plan was created for Claire; her treatment goals focused on improving her verbal expression (including naming, use of pronouns, use of relationship words,

and numbers), improving her written expression (writing complete and accurate sentences), improving her reading fluency (quickly and accurately reading words) and improving her reading comprehension. A summary of specific treatment goals can be found in Table 4. Clinicians involved in the program participated in weekly team meetings (including the participant) to review programs, training procedures, and client outcomes. These meetings also supported a client-centered approach and created an inclusive team culture. Materials were created using personally relevant and motivating themes for the participant, including family, travel, and medicine. For example, the participant's own family tree was used when targeting pronouns, and relationship words, naming targets included nouns such as "stethoscope" and "anesthesia," and the participant selected a fiction novel to target reading comprehension.

The client was highly engaged and motivated to attend the program and found intrinsic motivation in the programs and tasks themselves. The participant was encouraged to create a bulletin board with items that provided inspiration and motivation (ie, photos of her graduation, trips, family members, her partner, inspirational messages, and jokes) that hung on the wall of her treatment room for the course of her intensive program. In addition, the RBTs and SLP used positive verbal feedback (ie, praise appropriate for an adult, such as "you've got it" or "that's right, that trial was even stronger than your last!") and visual performance feedback (ie, showing the client graphic representation of her progress) as reinforcement in the treatment sessions.

The SLP sessions were focused on improving her oral language expression and written language comprehension. Goals were selected based on the client's input of perceived challenges, combined with information gathered by language assessments, with an overall goal to increase functional communication and life participation. Claire struggled to provide a clear verbal explanation; her responses were initially verbose, irrelevant, and/or confounded by many

grammatical, morphological, and word-finding errors. The participant struggled to "find the words" and found this to be a significant barrier in everyday conversations, therefore naming was targeted by the SLP (ie, generative naming using goal-driven categories)[52] and in ABA sessions (ie, through fluency training). Claire was taught "remembering strategies" (eg, visualizing herself in a grocery store when targeting generative naming of foods) and was taught to use sub-categories (e.g., fruit, produce, dairy, dry goods, etc.) to re-establish semantic networks and associations. Training atypical examples (ie, "things that you can buy in a souvenir shop") has been shown to strengthen semantic features and lead to generalization as these categories are not pre-established in memory.[52] The SLP used personally relevant and/or high-interest topics such as travel and family when creating targets whenever possible.

The SLP directly targeted the participant's ability to provide clear and concise verbal explanations (eg, tell me the 5 steps to making a bed), the accurate use of pronouns (ie, personal pronouns such as he/she, possessive such as his/hers, and reflexive such as himself/herself), and the use of logico-grammatical relationships[53] (eg, using correct relationship words such as brother, sister, cousin, to describe a relationship between 2 people in her family, and the reverse, such as "Angie is my daughter; I am Angie's mom"). These goals were selected based on client input combined with gaps identified in diagnostic assessment. SLP sessions also focused on improving her understanding of written language comprehensions. In her speech-language therapy sessions, Claire learned and used metacognitive reading strategies to improve her comprehension while reading a fiction novel of her choice. She actively summarized content that she read (ie, Claire took notes at the end of each chapter and notable details within chapters) and utilized supports such as creating a family tree to better understand the characters and their relationships.

Caregiver Training

Caregiver training is an essential component of an intensive aphasia program for several reasons: a) to educate the family about the individual's strengths and unique challenges, b) to support maintenance and generalization of skills taught in therapy sessions, and c) to improve conversations for both partners by acknowledging the competence of the person with aphasia.[42] Having better conversations at home using supported conversation strategies allows the person with aphasia to increase participation in their life beyond the treatment room. Claire's family, including her adult daughter, her two school-aged grandchildren, her adult son, and her partner, attended a caregiver training session in supportive conversation strategies[42] with the Speech-Language Pathologist. The SLP also provided information about Claire's communication strengths and challenges, treatment goals, and recommendations to maintain progress post-treatment.

RESULTS

In order to evaluate the participant's progress in the treatment program, clinicians analyzed data both qualitatively and quantitatively. Participant progress and goals were tracked daily by the RBTs and were reviewed with the BCBA and SLP on a weekly basis through direct observation, supervision, and team meetings. The SLP administered standardized assessments and diagnostic assessment tools pre- and post-intervention with the anticipation that we might see improvements on standardized assessments following treatment. Computations of effect sizes were used for standardized assessments in order to understand the effect of the intervention over and above what would be considered typical progression or development. Effect sizes were computed by subtracting the pre-treatment scores from the post-treatment scores divided by the standard deviation of 15. Cohen's[54] descriptive rankings of effect sizes were used, whereas .2

demonstrated a small effect, .5 demonstrated a moderate effect, and above .8 demonstrated a large effect. We used visual analysis and graphs to examine progress and improvement for measures that did not allow for computations of effect sizes.

Functional Language Skills

The first research question asked whether direct instruction using the BICA approach on specific activity-based language skills would improve functional language ability in the participant. The participant had identified challenges in the following areas that were directly targeted in treatment: describing a picture scene (see-say task), writing a sentence about a picture scene (see-write task), writing down a date (hear-write task), writing down a phone number (a hear-write task), telling time (see-say task), labeling printed numbers and prices (see-say tasks), using pronouns (see-say task) and labeling family member relationships (hear-say intraverbal). The participant's progress was evaluated by taking baseline data prior to intervention and running the same procedure at the end of treatment. For example, Claire struggled to construct and transcribe a grammatically correct sentence. Prior to beginning intervention, 10 pictures of world events (from a newspaper) were shown to Claire and scored on her ability to write a sentence using subject, verb, object, and function words in the correct order (eg, "The Queen is waving to the crowd"). Claire was given a full score if she accurately constructed the sentence (either tact or transcription) using the subject, verb, object format with correct grammar; she was provided half a point if she included at least 2 of the 3 pieces of information. Claire scored 5% at baseline and 100% post-treatment. Figure 2 provides more information on the baseline and post-test data for functional language skills targeted. It was also hypothesized that these functional language programs would also generate positive change on the diagnostic assessment tools. Claire demonstrated gains across domains on the Mt. Wilga High-Level Language Test.[50]

Individual elements of the assessment also showed improvement, even on aspects not specifically targeted for intervention (see Figure 3). On the aphasia domain of the Assessment for Living with Aphasia,[51] a self-reported measure of communication skills (talking, understanding, reading, writing, and aphasia overall), Claire's score increased from 58% (11.5/20) pre-intervention to 78% (15.5/20) post-intervention. Claire reported improvements across all domains with the exception of understanding language; this was attributed to her being more aware of what she did not understand after treatment targeting comprehension strategies.

Claire reported being frustrated with her use of paraphasias and her lack of awareness of these errors in conversation; she recounted stories of family members using humor to help her to overcome these challenges. As part of her treatment, Claire engaged in conversations with the RBT in a busy, distracting environment (such as a coffee shop or grocery store), and the RBT tracked the type, frequency, and response to her paraphasias. The RBT would make Claire aware of the paraphasia used in conversation and allow her to determine a repair strategy (ie, provide a verbal description, complete a Semantic Feature Analysis[55] chart, write out the word, or use a gesture). As a result, Claire's awareness of errors in conversation increased from 58% pre-treatment to 83% post-treatment, meaning that the participant could identify errors in her own speech and either correct or make attempts to repair any miscommunications. In addition, this increased awareness of paraphasias meant that she was better able to spontaneously correct errors in conversation, making her message more easily understood by her communication partner.

Naming

The second research question asked whether direct instruction on naming using the BICA approach would improve the participant's naming abilities. Standardized assessments

administered pre- and post-treatment demonstrated improvements in the participant's word-finding and naming ability (d = .2, indicating a small effect),[54] with standard scores on an expressive vocabulary measure (EVT-3)[47] increasing from 77 to 81 (where scores from 85 - 115 are within the average range). Clinicians used two parallel forms of the EVT-3 (i.e., Form A at pretest and Form B at posttest); the tests contained similar content and design with unique vocabulary items in order to demonstrate progress. The participant made improvements across three types of naming on the Mount Wilga High-Level Language Test[50] (ie, category naming, association naming, and divergent semantics); see results in Table 3. Category naming, which was directly targeted in treatment, improved from a moderate impairment pre-treatment to a normal response post-treatment.

Reading and Writing

The third research question asked whether targeted direct instruction using the BICA approach focused on reading and writing skills would improve the participant's abilities in written communication. The participant's reading was assessed on the Qualitative Reading Inventory (QRI-6)[48] and the Mount Wilga High Level Language Test[50] pre and post-treatment. At pre-test using the QRI-6, the participant read 6th level words with 65% accuracy (considered to be frustration level); by the end of treatment, she read 6th level words with 90% accuracy (considered to be at an independent level). Oral reading fluency was also assessed pre- and post-treatment. At baseline, the participant could read 29 words per minute accurately; by the end of treatment she increased to 49 words per minute. To improve the participant's reading comprehension, Claire was taught to use metacognitive reading strategies[56] while reading a fiction novel (ie, strategies known to help readers "think about their thinking" before, during, and after reading a text). At pre-test, the participant answered comprehension questions about the text

with 58% accuracy; by the end of therapy, she answered questions with 75% accuracy. Thus, her comprehension of the text improved markedly over the course of therapy, as did her overall confidence in reading. On the Mount Wilga High-Level Language Test,[50] Claire increased from a mild-moderate reading impairment to mild impairment (see Figure 3). On the Assessment for Living with Aphasia,[51] Claire rated her reading ability as 38% (ie, a score of 1.5/4) before treatment, which increased to 75% (a score of 3/4) post-treatment.

Quality of Life

The fourth research question asked whether the BICA approach would result in improved quality of life in the participant, as aphasia is known to have a significant negative impact on self-identity, relationships, confidence, and participation in life events.[7] Simmons-Mackie et al.[57] designed a valid and reliable measure to assess the quality of life (QOL) in people living with aphasia, the ALA, (including the aphasia domain and the "wall question"), which was administered both pre- and post-treatment. Before the intensive aphasia program, the participant reported that her aphasia was acting as a barrier or "wall," stopping her from doing things she wanted to do about 50% of the time (ie, a score of 2/4). Post-treatment, Claire reported that aphasia was no longer a "wall" and was able to participate in her life 88% of the time (ie, a score of 3.5/4). In addition, Claire reported feeling more confident being in the community alone and even took a trip to visit family.

DISCUSSION

This paper is one of the first case studies completed in the field of aphasia treatment to combine intensive treatment with the expertise of a speech-language pathologist and a behavior analyst. The authors developed the BICA approach out of a passion for aphasia and identified need. Having run community aphasia programs and provided 1:1 therapy for many years, the

second author was driven to pilot an intensive aphasia program that utilized the best practices from the SLP field integrated with the intensive approach well known to the field of ABA. This case study aimed to demonstrate the effectiveness of a functional approach to language combined with best practice research in aphasiology.

This study aimed to evaluate whether the BICA approach was effective in improving: a) functional communication abilities, b) naming abilities, c) reading skills, and d) quality of life for the participant. Overall, the novel intensive aphasia program combining a linguistic and behavioral interpretation of language and aphasia was demonstrated to be successful for an individual with aphasia. Claire improved in functional communication skills such as her ability to use appropriate pronouns and family words in a sentence to have a conversation about her family members. As a proud mother and grandmother, Claire truly valued being able to share stories about her family with her partner and her social network. Before treatment, Claire rarely referenced the relationship when speaking about family (ie, neglecting to identify Bill as her "son" when the communication partner didn't know her family members' names) and was unable to accurately describe her relationship when asked (ie, when asked, the participant would say, "I am Bill's son" when she meant, "Bill is my son"). Conversations were often confusing and hard to follow as a result. Pronouns and relationship words were targeted intensively in the program. By the end of treatment, Claire was able to identify and explain the relationships within her family nearly all of the time. She markedly improved in her ability to write out dates and times, which was an important functional skill allowing her to accurately record details of an upcoming appointment from a phone call or voicemail. Claire's naming ability improved following intensive practice and instruction using semantic feature analysis,[55] and by using strategies to re-establish semantic networks and associations. Before treatment, Claire had a moderate

impairment in category naming; this improved to a normal response by the end of treatment. Difficulty "finding the words" is a hallmark of aphasia and was observed in the participant pre-treatment; following intensive practice, her category naming improved from a moderate impairment to a normal response. She improved in her ability to describe a word (ie, using the unique semantic features) so that she or her communication partner could arrive at the word and avoid conversation breakdown.

Before therapy, Claire reported much frustration with reading, particularly in understanding what she read. Reading had once been a source of joy, connection, and education; due to the aphasia, Claire reported she struggled to comprehend emails, newspapers, notices, and novels. Reading was directly targeted in her treatment sessions with the SLP and RBT, and her ability to read quickly and accurately improved, as well as her comprehension and overall confidence in reading. By the end of treatment, Claire was able to independently read a fiction novel and reported looking forward to finding her next book to read for pleasure.

Interprofessional collaboration between the SLP and BCBA was critical to the success of this program. The BICA program demonstrated that effective collaboration between these disciplines could add value to the treatment of aphasia. SLPs and BCBAs have complementary areas of expertise whereby the knowledge base and perspective of one can enhance the knowledge base of the other.[21] Interprofessional collaboration allowed the participant to benefit from a client-centered program that embraced the unique contributions and shared values of the clinical team.

Claire's data highlights improvements in multiple areas of language form and use, however the real impact of the program was evident in her improved confidence and quality of life. Following the intensive aphasia program, Claire reported doing things she hadn't done for a

long time, such as making small talk with strangers out in the community. She went on a trip to visit her son and independently navigated elements of traveling such as communicating in a busy airport, asking for directions on the street, ordering her own meals, and participating in conversations with family and friends. The impact of aphasia can rob an individual of the ability to carry out these tasks independently. The intensive program helped Claire to regain confidence and the ability to return to living her life. She continued to be a strong advocate for people with aphasia acting as a patient advisor on a working committee for a local stroke network.

Limitations and Future Directions

There is still much to be done to define the specifics surrounding an intensive aphasia program. The current study is a small applied intensive aphasia program that consisted of several variables (eg, instruction, prompts, reinforcement, etc.) and, thus, it is impossible to say which variables were integral to the program's success.

Further, the current study was a case study design which poses its own limitations. The results indicate that this intensive aphasia program was effective for this participant, though the external validity requires further analysis. The specifics surrounding who would benefit from this type of intervention remain unknown. This case study has several limitations; the first is the inability to reverse treatment effects. A case study is a useful design to gain an understanding of complex issues and begin preliminary research but is not as strong as an experimental design, however, given this is an applied study, the purpose was intended to demonstrate support for the concept. Case studies are often questioned due to the lack of reversal of treatment effects as well as the inability to rule out history (ie, the influence of external factors) or maturation (ie, spontaneous improvement in the participant) as potential explanations for treatment effects.[58] The participant was not receiving any other 1:1 direct treatment while she participated in the

intensive program, and therefore it is unlikely that history was a factor in the results observed. Further, maturation was also unlikely to be a contributing factor as she was 2-years post-stroke when she began treatment. Further studies should look to replicate a behavioral conceptualization of aphasia and include collaboration between SLPs and BCBAs to assess treatment effects. Future studies should also examine long-term maintenance and generalization of skills. It would be advantageous to look at various intensity models to determine how many hours per week is the most effective and when does this level out. While it has been established that intensive aphasia programs are beneficial, it is important now to determine the exact variables that make an intervention effective.

Clinical Recommendations:

The findings from this case study support the value of an intensive aphasia program for individuals with reduced communication skills after a stroke. The novel collaboration between speech-language pathologists and behavior analysis is apparent in the gains this individual made. In summary:

- A linguistic approach to language processing in aphasia is useful for understanding the individual's unique skills and challenges in relation to oral and written language skills
- A behavioral approach to defining language is useful for identifying the teaching methods based on the function of language and verbal operants
- The BICA approach was useful for treating functional, relevant goals that result in meaningful change for the participant
- Using dynamic assessment, a person-centred approach, and actively involving the client's values and needs in all aspects of assessment and treatment (ie, using data and progress

graphs as reinforcement; engaging the client in the assessment process) was useful for treating the participant with aphasia

Conclusion:

The ultimate goal of the BICA approach was to increase the participant's functional communication skills, communication confidence, and increase participation in her life. The program followed guidelines from the Best Practice Recommendations for Aphasia,[57] wherein the individual with aphasia was offered individualized and intensive aphasia therapy that had a meaningful impact on her life and communication. In line with these recommendations, the therapy program was collaborative, person-centered, and involved training in SCA(™)[42] and aphasia for both the individual and her communication partners.[57] This participant surely benefitted from participating in the intensive program and had a renewed confidence in her ability to participate in conversations at home, with her family, and in the community.

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Conflict of Interest Statement

Shawna Fleming & Brittany Clark received a salary from the private clinic in Canada where the intensive aphasia program was completed.

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Figures

FIGURE 1 Baseline and post-treatment scores for Claire on a skill acquisition program focused on increasing her ability to write dates told to her orally.

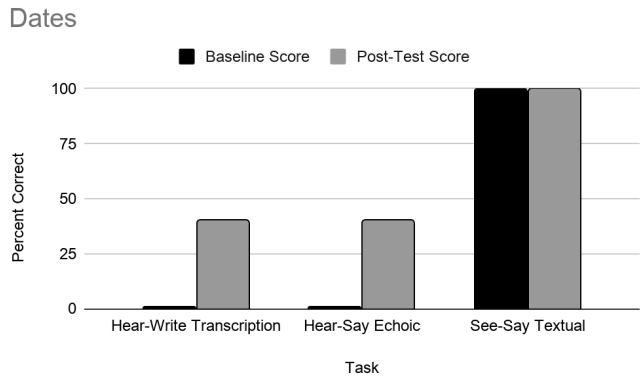


FIGURE 2 Baseline and post-treatment scores for Claire on intervention programs.

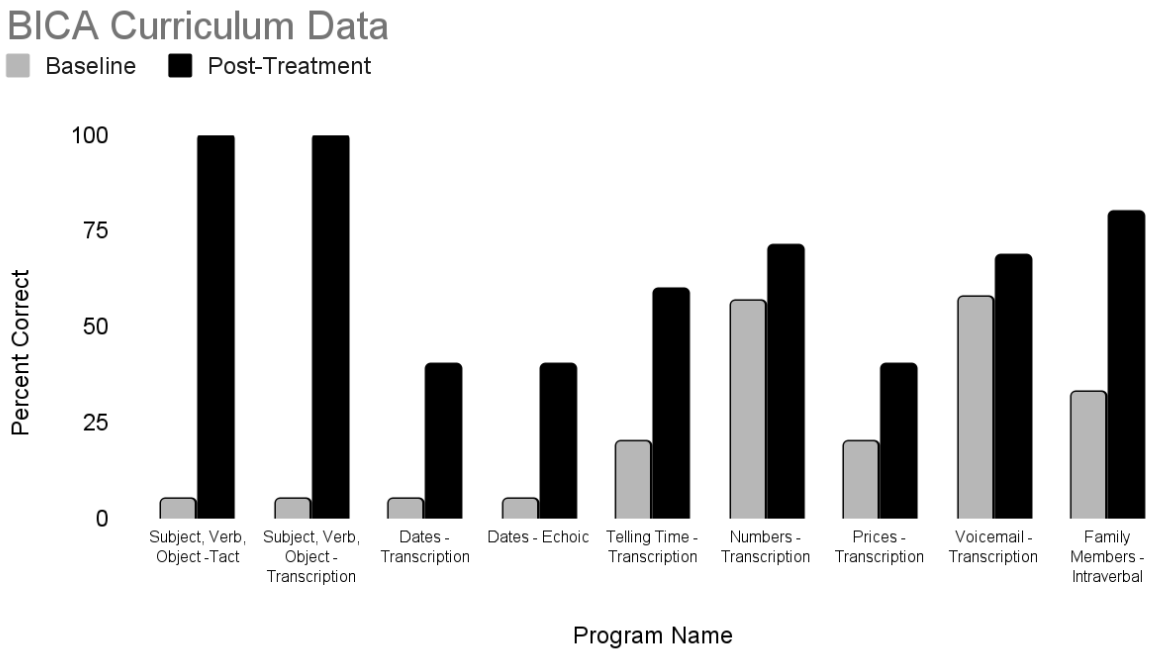
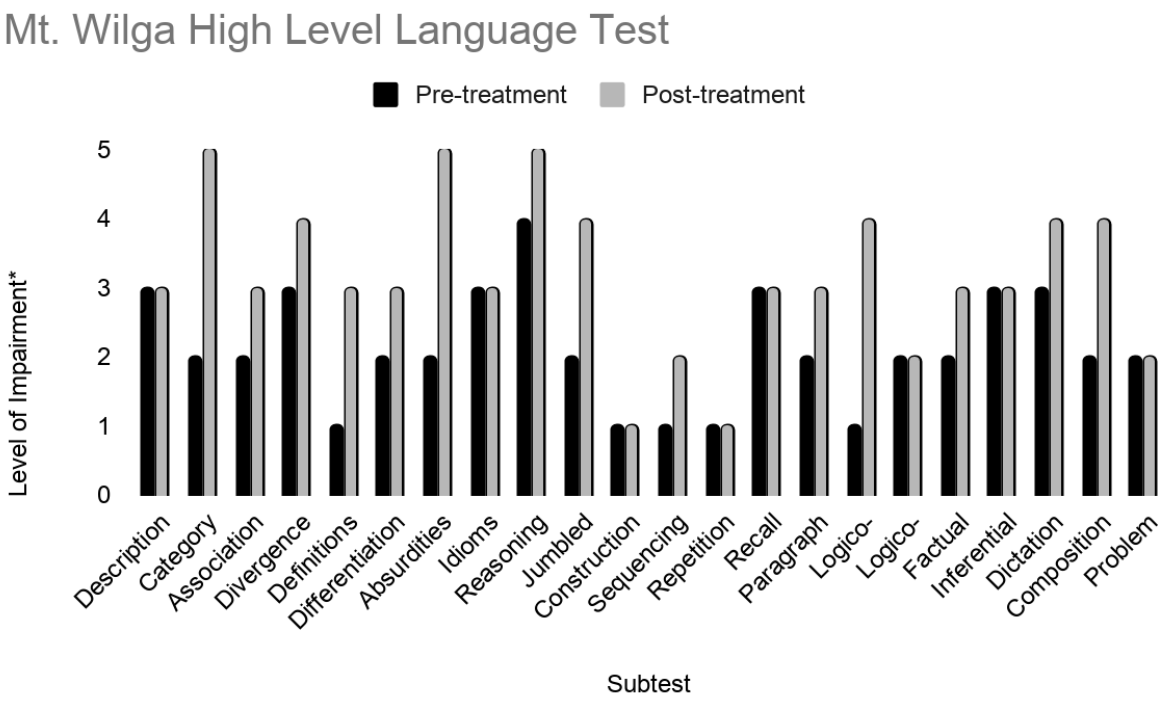


FIGURE 3 Pre- and post-treatment scores on the Mount Wilga High Level Language Test for Claire.



*Level of impairment: 1 = severe impairment, 2 = moderate impairment, 3 = mild impairment, 4 = mild reduction in fluency, 5 = normal response

TABLE 1: Treatment schedule for Claire

	Monday	Tuesday	Wednesday
9:30 AM - 12:30 PM	1:1 treatment with RBT	1:1 treatment with RBT	1:1 treatment with RBT
12:30 PM - 1:00 PM	Lunch break	Lunch break	Lunch break
1:00 - 2:00 PM	1:1 SLP treatment	1:1 SLP treatment	1:1 treatment with RBT “life skills”
2:00 - 3:00 PM	+ 30 mins SLP treatment	+ 30 mins SLP treatment	

Additional 1-hour of SLP treatment added as per client request; 30-minutes two-days per week.

TABLE 2: Team role division

Team Role Division	BCBA	SLP	RBTs	Participant
Conducted Initial Language Assessments		✓		
Determined program goals	✓	✓		✓
Developed data collection procedures	✓			
Determined prompting procedures	✓			
Implemented treatment		✓	✓	

Clinical observations and supervision of RBTs	✓	✓		
Assess participant progress and program success	✓	✓		
Participated in team meetings to review progress	✓	✓	✓	✓

TABLE 3 Results of diagnostic assessments pre- and post-treatment.

Measure	Pre test score	Post test score
EVT-3+	77 (CI 74-80)	81 (CI 78-84)*
QRI-6		
Sight words (6th grade)	65%	90%
ALA		
Aphasia Domain	58%	78%
Wall Question	50%	88%

+Mean Standard Score = 100, Standard Deviation = 15.

Note: EVT-3 = Expressive Vocabulary Test, 3rd Edition Form A used at pre test, form B used at post test; QRI-6 = Qualitative Reading Inventory, 6th Ed.; ALA = Assessment for Living with Aphasia, CI = 95% confidence interval

*Small effect (.2)

TABLE 4 Intensive Aphasia Program: Participant Goals

Goal	Clinician	Description	Type
Improve verbal expression	SLP	Improve ability to independently and accurately provide 5 concrete and concise steps for a verbal explanation given a verbal prompt (ie, “tell me in 5 steps how to make a cup of coffee”)	hear-say
Improve naming	SLP + RBT	Improve generative naming using ad-hoc goal-derived categories[52] (ie, things to pack for a hike) with SLP, and fluency training with RBT using the Semantic Feature Analysis[55] chart for error correction	hear-say
Improve use of pronouns	SLP + RBT	Improve use of personal (he, she, they) and possessive pronouns (his, hers, their) using fluency training to improve speed and accuracy	see-say
Improve expression of relationship and family words	SLP	Improve expression of logico-grammatical relationships[53] by accurately using appropriate relationship word to describe a relationship between two individuals in her own family (eg, “tell me how you and Bill are related”)	hear-say
Improve ability to listen to, repeat, and/or write numbers	RBT	Improve ability to listen to and repeat strings of numbers (including numbers and prices up to 5 digits, such as $149.89)	hear-say hear-write
Improve ability to write complete, accurate sentences	RBT	Improve ability to write a grammatically correct and complete sentence using the sentence + verb + object (SVO) sentence structure, such as “the man is waving a flag”	see-write
Improve reading fluency and comprehension	SLP + RBT	Improve reading words quickly and accurately (with RBT) using fluency training Improve reading comprehension using metacognitive reading strategies[56] (with SLP)	see-say
Improve confidence in conversation and quality of life	SLP + RBT	Improve confidence in conversations (with RBT)	hear-say