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

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**Abstract**

Aphasia is a common, acquired disorder affecting all language components of the brain across modalities, most often due to a stroke or other brain injury. While commonly therapeutic approaches can result in some improvements, multiply studies establish that intensive therapeutic interventions are most effective; however, these approaches are not well defined. The purpose of the current study was, therefore, to examine the efficacy of a novel, behaviorally-oriented, intensive communication therapy for aphasia (BICA) 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 focusing 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 Speech-Language Pathologists and Board-Certified Behavior Analysts can collaborate in providing effective aphasia treatment
* Contrast a linguistic vs. behavioral interpretation of aphasia
* Define the six verbal operants used in the behavioral interpretation of aphasia

**Disclosures**

Both authors in this study received a salary from the private clinic where services were provided.

**BACKGROUND**

Worldwide, stroke is the leading cause of adult disability, with aphasia being one of its common, life-altering outcomes. A communication impairment that can affect all language components (phonology, morphology, syntax, semantics, and pragmatics) across modalities (speaking, reading, writing, and listening), research has shown that one in every three stroke survivors has symptoms of aphasia.3,4,5 Aphasia significantly impacts quality of life, limiting the ability to convey feelings of pain, hunger, depression, or to express desires, needs or thoughts. The resulting isolation may be further heightened when others assume that the person with aphasia is not competent or simply has nothing to say.

Given both the prevalence of aphasia and its impact, effective treatments are essential. Improvements in communication skills have been shown to lower frustration and depression among individuals with aphasia and to decrease caregiver burnout.7 However, there are specific deficits in aphasia therapies that must be addressed if treatment is to significantly improve the quality of life for those with aphasia and their communication partners.

Currently, aphasia treatments fall in one of three categories: community aphasia programs; one-to-one speech-language therapy; and intensive aphasia programs. While each offers unique benefits to the client, each has shortcomings that limit their impact on reducing symptoms of aphasia.

**Community Aphasia Programs**

When available, community aphasia programs offer individuals 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. Such programs are generally seen as maintenance programs and 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 [reference needed].

**One-to-One Therapy**

Some individuals with aphasia may receive direct one-to-one therapy with a Speech-Language Pathologist (SLP) to work on improving speech and language skills. Such therapy may be offered in the hospital, in private practice, or as part of outpatient rehabilitation programs or funded therapy in the community. Limitations include access, eligibility, and effectiveness. First, available public and private insurance support may limit access directly or via caps on the length of time which therapy can be received. In addition, access is affected by the availability of community programs offering one-to-one therapy.

 Perhaps the most important shortcoming of most one-to-one therapeutic approaches for treating aphasia is the fact that such therapies are typically offered only for between one and five hours a week. Research has shown that this level of intensity is not sufficient11 and typically results in no additional functional language recovery beyond that which can be achieved with spontaneous recovery.9 In fact, in order to make significant gains beyond spontaneous recovery, it is likely that at least double this intensity is required.11

**Intensive Aphasia Programs**

Intensive aphasia programs involve mass practice and repetition, applying principles of neural plasticity, and studies have shown that they are more likely to result in communication improvements after brain injury.15 For example, a 2016 Cochrane Review (Brady et al.10) supports this conclusion, reporting that functional communication was significantly better following intensive treatment for some individuals than those who received therapy at a lower intensity. Bhogal et al.9 found that an intensive, comprehensive aphasia program that provides 5-10 hours per week of intervention over an eight to twelve week period showed strong treatment effects as opposed to a program that provided two to four hours per week for 20-26 weeks.9 Research has also demonstrated that short periods of intensive therapy for post-stroke aphasia can be very effective in improving communication abilities.12,13 Similarly, Luccese and colleagues14 found that highly intensive speech therapy providing 10.5 hours per week for four weeks resulted in language improvements.

In addition to the need for more hours and longer treatment, other studies point to needed characteristics of intensive aphasia programs. In their survey of international intensive aphasia programs, Rose et al.15 suggest that such programs 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. In addition, intensive programs should take a holistic approach, targeting a combination of impairment-based, function-based, and activity-based skills,15 and incorporating the client’s needs and values. Despite these findings, however, the optimal dose, frequency, form, and duration are yet to be defined due to disparities in research methodologies.17 Moreover, such program elements would benefit from professional skills that complement those of the SLP. However, while is now collaboration across professions has yet to be introduced into

Despite its promise, 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. As a result, the majority of existing programs look to the traditional, medical model of speech pathology to guide the treatment.

**INTERPROFESSIONAL COLLABORATION**

Interprofessionalism is a process undertaken by professionals from different disciplines who establish a foundation of shared values, ethics, and standards, to 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, as Speech-Language Pathologists (SLP) have the specific training, skills, and competencies for 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, however, have experience treating in an intensive model, nor is the research in intensive SLP rehabilitation is not conclusive or prescriptive. Incorporating other professionals and interprofessional practice more generally 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 providing intensive, comprehensive therapy services with a focus on working across many domains simultaneously. Applied Behavior Analysis (ABA) uses learning theory to improve the human condition in ways that can be applied to many populations. While ABA therapy has been shown to be an effective treatment for autism [ref needed?], it can be applied to many populations, including those with aphasia.

Aphasia, as a heterogeneous and often idiosyncratic disorder, requires 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 professional collaboration. Behavior analysts, however, are specifically trained on the single case study design, which can be useful when treating conditions like aphasia and evaluating outcomes. In addition, BCBAs can add value to interdisciplinary teams because they focus on measurement, accountability, and evidence-based treatments and 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, such as the use of verbal operants.

There is overlap in areas of competency between SLPs and BCBAs. Both professionals , and both are trained to assess and treat receptive and expressive language deficits. There have been reports that, in some settings, SLPs and BCBAs have been at odds with one another due to misunderstandings about respective scopes of practice and incorrect stereotypes about each discipline.21 There are established paths by which a successful SLP and BCBA collaboration could be supported which involve establishing a foundation of shared values and 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, however, account for all of a person’s unique linguistic profile. For individuals with aphasia, it is often not the entire receptive or expressive repertoire that is impacted, a feature of aphasia that 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 instance, the response is due to visual stimuli in the environment (i.e., seeing a ball), whereas in the latter case, the response is provided as a result of the verbal behavior of another person (i.e., 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’s23 *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 Skinner23 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 (e.g., 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.

In this context, the verbal operants first defined by Skinner23 as a way of defining language based on its function are particularly useful. 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 Skinner23 defined seven verbal operants which he defined as follows:

* *Echoics* involves imitating a spoken word – saying, for example, “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 after hearing it – hearing the word “ball” and writing b-a-l-l.
* *Textual* refers to seeing a written word and then reading it aloud.23

Echoics, transcription, and textual responses tend to be easier to emit and thus have a simpler minimal repertoire. As such, they tend to survive longer post-stroke.22

* *Mand* refers to the language used to obtain something desired (e.g., 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 – for example, seeing a ball and saying “ball” – and is occasioned by a nonverbal stimulus, with the consequence being a social response from the listener.23
* *Intraverbal* refers to responding to the spoken language of someone else whereby the antecedent is the verbal behavior of someone else and the consequence is a social response from another person – for example, saying “ball” after someone says “it’s something you throw”.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, Haughton30 created a learning channel matrix that focused on the stimulus input (i.e., see, hear, or touch) and response output (i.e., say, write, or point). For example, a person with aphasia might see a book and say “book,” which would be classified as a see-say tact. Although 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 for more precisely defining language and identifying 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 from simply topography to the function of language. Further, a behavioral interpretation of aphasia focused on observed deficits and treatments to remedy those deficits is an alternative to the traditional approach, where the type of aphasia was directly related to, or named for, the damaged area of the brain.32

Importantly, 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 to examine the speaker-listener environment (antecedent-consequent variables) in which the error occurred.31 If omitted 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, Patterson33 highlighted the importance of utilizing prompts that are appropriate for the individual’s specific impairment (i.e., 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.

Sidman34 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, such as 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 (i.e., identifying a picture of an apple in an array) while in the second it is fractured (i.e., 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 defining and assessing language for individuals with aphasia. In this study, two stimulus control transfer procedure methods were compared and the functional approach was shown to be effective and useful. Other studies focused on the rehabilitation of language for older adults support similar findings, namely that a functional approach to language is effective, useful and enables clinicians to create an individualized intervention strategy.37-40 For example, Mozzoni41 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 operants22 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. To date, the primary focus has been on populations, like those with autism, who have never had an extensive verbal repertoire. Recent research indicates there is a utility in applying this framework in rehabilitation efforts with those who had intact repertoires that have been impacted by brain injury or aging.

**METHODS**

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 integrated a linguistic model based on topography with a behaviorally-informed verbal operants’ model based on functionality to identify specific deficits, to develop meaningful goals for the individual, and to create a dynamic teaching program. 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 result in significant affirmative answers to each of these questions, as predicted by the theoretical and empirical soundness in the research on intensive aphasia treatment reviewed above and supported by the behavioral interpretation of aphasia.22

**Program Overview**

The BICA program targeted the participant’s language impairments and participation/functional language skills; provided 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, including one-to-one treatment with multiple instructors across a variety of clinical and functional settings, supported by both technology and homework. The program consisted of 12-13 hours of training per week. Instruction was provided by the SLP (second author) for two to three hours a week, and Registered Behavior Technicians (RBT®) who [did \_\_\_\_\_] for 10 hours per week and who were supervised by the BCBA (first author). (See Table 1 for the treatment schedule.)

The total time of the intensive program was \_\_ hours provided over 12 weeks. The first week consisted of collecting 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 approach43 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 (e.g., selecting a goal to successfully retrieve information from a voicemail) and interpreting her performance on standardized assessments (i.e., 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. To ensure that targets were selected based on the client’s interests, needs, education, and background, the participant was involved in selecting appropriate functional goals and themes for language targets..

**Participant**

The participant was a 71-year old Caucasian, monolingual woman with aphasia post left-hemisphere CVA in 2017. Two years after her stroke, Claire (name changed to maintain client confidentiality) contacted the private clinic where treatment was provided to inquire about participating in an intensive aphasia program. She previously received individual one-to-one speech therapy for more than one year, and had participated regularly in weekly community aphasia programs, but 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, although her immediate family members were actively involved in her life. She also had a supportive partner who not only assisted her in articulating her unique challenges, but was involved in selecting functional treatment goals.

**Setting**

The participant attended the treatment clinic three days per week for therapy sessions which were held at approximately the same time each day. If a session needed to be skipped for any reason, attempts were made to reschedule. Sessions included 10 hours per week of one-to-one 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 a natural environment, such as inside a coffee shop or a grocery store for at least one hour every week.

**Assessment Measures**

Claire’s language was assessed using a number of both standardized and informal measures before treatment to identify her baseline strengths and challenges, and to determine goals for the program. The SLP administered the Western Aphasia Battery-Revised (WAB-R),44 and Claire was found to have ‘mild’ aphasia with anAphasia Quotient of 85.5 (an AQ of 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 (i.e., “bastry” for *pastry*), semantic (“mom” for *daughter*), and neologistic paraphasias (i.e., “igit” for the word *describe*) in conversation.45 Claire was aware of errors just 58% of the time in a one-hour conversation sample that took place pre-treatment). When Claire was aware of her errors, she would either self-correct (i.e., saying, “*Pitsdelia... No, that’s not right, it’s Pittsburgh*”); repeat variations of the word multiple times until she arrived at the correct word (i.e., saying “*line… lane... plane... no, it’s a runway!*”); or say the word with a questioning intonation (i.e., “*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, achieving a high-average understanding of single words using the Peabody Picture Vocabulary Test, 5th Edition (PPVT-5) – a standard score of 109 (CI 105-113), where average scores fall between 85-115.46 The SLP assessed Claire’s expressive vocabulary using the Expressive Vocabulary Test, 3rd Edition (EVT-3)47 which found that her receptive vocabulary was significantly greater than her expressive vocabulary, with an EVT-3 Standard score of 77, where average scores fall between 85-115, compared to PPVT-5 Standard score of 109, a significant difference (p=0.05).

The PPVT-5 and EVT-3 were used for three reasons. First, the tests include 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, allowing for direct comparisons between expressive and receptive vocabulary knowledge. Finally, 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, we 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 Claire’s understanding of words was significantly greater 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 sentences containing a subject, verb, and object (SVO) structure, achieving 0% on a pretest using \_\_\_\_. She also had difficulty understanding written language, as indicated by her ‘score’ at the “frustration” level when answering comprehension questions on a 6th-grade reading passage on the Qualitative Reading Inventory (QRI-6).49

In addition to the Aphasia Battery (WAB-R),44 the receptive (PPVT-5)46 and expressive (EVT-3)47 language assessments administered prior to treatment, the SLP administered additional diagnostic assessments such as the Mount Wilga High Level Language Test50 and the aphasia domain on the Assessment for Living with Aphasia (ALA)51 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 and for the authors to present her information, goals, and progress in this paper. The assessments and intervention sessions were part of her regular treatment program. Dynamic assessment43 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 two sessions, the prompt level was increased.

Treatment fidelity checks and interobserver agreements were taken during regularly scheduled observations by the SLP or BCBA and involved a minimum of 10% of total participant hours. The main dependent variable in all tasks was the number of correct responses out of 10 opportunities, or the 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 (i.e., 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, and (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, among Claire’s goals was to be able to write down a date after it was told to her (e.g., 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 was 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 were obtained and the teaching procedure was written, the BCBA and SLP would train the RBTs on how to implement the program who would then 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. A goal was considered mastered when Claire achieved over 90% for three consecutive days, after which maintenance and generalization efforts were completed and these goals were practiced less frequently and conducted within more naturalistic conditions (such as in a grocery store with background noise).

**Treatment Goals**

An individualized treatment plan was created for Claire reflecting both her baseline scores and her own goals. 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 (see Table 4 for summary). Clinicians involved in the program participated in weekly team meetings with Claire to review programs, training procedures, and treatment outcomes, a practice that not only supported a client-centered approach, but helped to create an inclusive team culture. Materials were developed 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. She was encouraged to create a bulletin board with items that provided inspiration and motivation (such as photos of her graduation, trips, family members, her partner, inspirational messages, and jokes) to hang on the wall of her treatment room throughout the course of her intensive program. To offer reinforcement during the treatment sessions, the RBTs and SLP used positive verbal feedback (for example, offering 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 (i.e., showing the client graphic representation of her progress).

The sessions led by the SLP focused on improving Claire’s oral language expression and written language comprehension, with selected goals based on her input about perceived challenges, combined with information gathered by language assessments, guided by the overall goal of increasing her functional communication and life participation. At baseline, 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. She struggled to “find the words” and found this to be a significant barrier in everyday conversations, therefore ‘naming’ was targeted by the SLP (through generative naming using goal-driven categories)52 and in ABA sessions (through fluency training).

Claire was taught “remembering strategies” (e.g., visualizing herself in a grocery store when targeting generative naming of foods), in addition to how to use sub-categories – like fruit, produce, dairy, dry goods – to re-establish semantic networks and associations. Training using atypical examples, such as “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 (e.g., tell me the five steps to making a bed), the accurate use of personal, possessive and reflexive pronouns, and the use of logico-grammatical relationships,53 such as using correct relationship words such as brother, sister, cousin, to describe a relationship between two people in her family, as well as 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 written language comprehension in which Claire learned and used metacognitive reading strategies to improve her comprehension while reading a novel of her choice. She actively summarized content that she read by taking notes on the significant details as she finished each chapter, 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 caregiver, support person, and 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 on strategies for engaging in supportive conversation42 with the Speech-Language Pathologist. The SLP also provided the family with information about Claire’s communication strengths and challenges, treatment goals, and recommendations to help maintain her progress post-treatment.

**RESULTS**

In order to evaluate the participant’s progress in the treatment program, clinicians analyzed both qualitative and quantitative data. Participant progress and goals were tracked daily by the RBTs and these qualitative observations were reviewed with the BCBA and SLP on a weekly basis through direct observation, supervision, and team meetings. In addition, the SLP administered standardized assessments and diagnostic assessments pre- and post-intervention to enable cto calculate impact. Effect sizes were computed by subtracting the pre-treatment scores from the post-treatment scores divided by the standard deviation of 15. Cohen’s54 descriptive rankings of effect sizes were used, where 0.2 demonstrated a small effect, 0.5 demonstrated a moderate effect, and above 0.8 demonstrated a large effect. We used visual analyses and graphs to examine progress and improvement for measures that did not allow for computations of effect sizes.

**Research Question 1: 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 comparing baseline data to data at the end of treatment. For example, prior to treatment Claire struggled to construct and transcribe a grammatically correct sentence when shown 10 pictures of world events and asked to write a sentence about them using subject, verb, object, and function words in the correct order (for example, “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 scored half a point if she included at least two of the three 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 which 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, and 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 natural 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, such as providing a verbal description, completing a Semantic Feature Analysis55 chart, writing out the word, or using a gesture). As a result, Claire’s awareness of errors in conversation increased from 58% pre-treatment to 83% post-treatment, meaning that she learned to 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.

**Research Question 2: 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 =*0.2, 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 (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 including 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.

**Research Question 3: 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, which was assessed pre and post-treatment using the Qualitative Reading Inventory (QRI-6)48 and the Mount Wilga High Level Language Test.50. 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, Claire 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 her reading comprehension, Claire was taught to use metacognitive reading strategies while reading a novel (i.e., strategies known to help readers “think about their thinking” before, during, and after reading a text. 56 At pre-test, she answered comprehension questions about the text with 58% accuracy; by the end of therapy, she answered questions with 75% accuracy. Not only did her comprehension of the text improved markedly over the course of therapy, but so 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% (a score of 1.5/4) before treatment, which increased to 75% (a score of 3/4) post-treatment.

**Research Question 4: Quality of Life**

The fourth research question asked whether the BICA approach would result in improved quality of life, as aphasia is known to have a significant negative impact on self-identity, relationships, confidence, and participation in life events.7 As part of their Assessment for Living with Aphasia (ALA), Simmons-Mackie et al.57 designed a valid and reliable measure to assess quality of life (QOL) for people living with aphasia and was administered both pre- and post-treatment. Before the intensive BICA 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 (a score of 2/4). Post-treatment, Claire reported that aphasia was no longer a “wall” and that she was able to participate in her life 88% of the time (a score of 3.5/4). These results were affirmed by qualitative observations that 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 to examine the impact of a novel, intensive treatment for aphasia that combines the expertise of a Speech-Language Pathologist with that of a Behavior Analyst. The authors developed the BICA in response to a clear need among those struggling with this common outcome of brain injury for better therapies. Having run community aphasia programs and provided one-to-one therapy for many years, the second author understood the limitations of current therapeutic approaches to treating aphasia. Moreover, the importance of ABA in other fields clearly indicated its promise as part of an intensive aphasia program. The result, we hope, is a powerful approach that utilizes the best practices from the SLP field with the intensive approach well known to the field of ABA. Using a case study of a client who experienced a stroke two years earlier, we aimed to demonstrate the effectiveness of a functional approach to language combined with best practice research in aphasiology.

The results indicate that 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. Combining a linguistic and behavioral interpretation of language and aphasia successfully improved all three language domains and quality of life for an individual with aphasia two years following a stroke.

These outcomes alone, however, fail to capture either the impact of the BICA treatment on one individual or its promise as an approach that merits wider application for treating aphasia. 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 family when speaking about family (for example, 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, resulting in conversations that were often confusing and hard to follow. By the end of treatment, Claire was able to accurately use pronouns and to identify and explain the relationships within her family nearly all of the time. In addition, her ability to write out dates and times markedly improved, 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 also 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 (i.e., 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. Once a source of joy, connection, and education, Claire reported that she struggled to comprehend emails, newspapers, notices, and, especially, 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 novel and reported looking forward to finding her next book to read for pleasure.

The BICA program demonstrated that effective interprofessional collaboration between the SLP and BCBA was critical to successfully treating 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 interprofessional, behaviorally-informed intensive aphasia program. The current case study represents a small applied intensive aphasia program that consisted of several independent intervention variables (e.g., instruction, prompts, reinforcement, etc.). As such, it is impossible to evaluate which variables were integral to the program’s success, and the specifics surrounding who would benefit from this type of intervention remain unknown.

Further, case studies have several limitations that require external validation and further analysis. Case studies are often questioned due to the lack of reversal of treatment effects, as well as their inability to rule out other explanations for treatment effects, such as history (i.e., the influence of external factors), or maturation (i.e., spontaneous improvement in the participant).58 While we affirm these limitations, we also point out that the participant was not receiving any other one-to-one 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 the participant was already two years post-stroke when she began treatment. Future studies should also examine long-term maintenance and generalization of skills. In addition, it would be advantageous to look at various intensity models to determine at what level of intensity do benefits begin to level out.

Finally, noting that while a case study is not an experimental design, it is useful for gaining a better understanding of complex issues and beginning preliminary research. As such, it demonstrated sufficient support for the BICA concept to merit further studies aimed atingthatinterprofessional

**Clinical Recommendations:**

The findings from this case study support the value of a behaviorally-informed intensive aphasia program for individuals with reduced communication skills after a stroke. The benefits of the novel collaboration between Speech-Language Pathologists and Behavior Analysts 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-centered approach, and actively involving the client’s values and needs in all aspects of assessment and treatment 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, her communication confidence, and her 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.

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**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 PM - 2:00 PM  | 1:1 SLP treatment | 1:1 SLP treatment | 1:1 treatment with RBT “life skills” |
| 2:00 PM - 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 categories52 (ie, things to pack for a hike) with SLP, and fluency training with RBT using the Semantic Feature Analysis55 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 relationships53 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-sayhear-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 trainingImprove reading comprehension using metacognitive reading strategies56 (with SLP)  | see-say  |
| Improve confidence in conversation and quality of life | SLP + RBT  | Improve confidence in conversations (with RBT) | hear-say |