

5-10-2020

## The Efficacy of Intensive Application of Schuell's Stimulation Approach for Chronic Wernicke's Aphasia: An Analysis and Comparison

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The Efficacy of Intensive Application of Schuell's Stimulation  
Approach for Chronic Wernicke's Aphasia: An Analysis and  
Comparison

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B.S., Northeastern University, 2018

A Thesis

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Master of Arts

At the

University of Connecticut

2020

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# APPROVAL PAGE

Masters of Arts Thesis

## The Efficacy of Intensive Application of Schuell's Stimulation Approach for Chronic Wernicke's Aphasia: An Analysis and Comparison

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## **Acknowledgments**

I would like to thank Dr. Jennifer Mozeiko for her instrumental insight and assistance throughout every stage of both the project and paper, as well as Dr. Carl Coelho and Dr. Emily Myers for their valuable feedback on this paper. I also want to acknowledge Shivani Padhi and her helpful (and very timely) assistance in transcribing the discourse probes. And finally, I wish to thank our participants and their families, without whom this research would not have been possible.

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## Abstract

**Background:** Roughly one million people in the United States are living with aphasia, and Wernicke's aphasia is the most common fluent type. Few treatment options have been thoroughly researched for Wernicke's aphasia; a major obstacle with these patients is lack of awareness of errors. For persons with aphasia in general, it has been found that more intensive treatments are more effective, as long as the treatment is not overly fatiguing and does not lead to drop-out. One intensive treatment is Schuell's stimulation approach, which focuses on bombardment of the auditory modality in order to effect improvement across all modalities.

**Aims:** The primary aims of this study were twofold: to investigate the feasibility of intensive Schuell's stimulation for a participant with chronic Wernicke's aphasia, and to explore whether such an intensive treatment is reasonable or would lead to fatigue and drop-out. A secondary aim was to compare the results of the current study to a similar study done in 2017, using the same treatment with a participant with nonfluent aphasia.

**Methods and Procedures:** The participant was M, a 77-year-old female living with chronic severe Wernicke's aphasia as the result of a stroke. M participated in a 10-day, 30-hour Schuell's stimulation regimen involving intensive bombardment of auditory comprehension and production using picture cards and verbal commands. Before, immediately after, and five- and ten-weeks post-treatment, M was given an assessment battery including the WAB-R-AQ, the CLQT, the CETI, and others. Before, during, and at all times post-treatment, M was probed for confrontation naming, auditory comprehension, and discourse production. Her performance was assessed on trained tasks and for generalization to untrained tasks and discourse.

**Outcomes and Results:** M improved on trained probe items but showed no generalization to untrained probes or discourse. She improved on some standardized measures,

including the WAB-R-AQ, and declined on others, including the CLQT. Her performance on language measures improved more than her performance on cognitive measures. The administering clinicians, as well as M's family and M herself, noticed qualitative improvements in M's communicative abilities, as noted on the CETI and in discussions with M and her family.

**Conclusions:** The application of intensive Schuell's stimulation did effect improvements in language in a participant with chronic severe Wernicke's aphasia. There was a lack of measurable generalization; however, the participant and those who interacted with her noticed improvements in her everyday communication. Schuell's stimulation is not meant to train functional language, and it may be that this treatment needs to be combined with a more functional treatment, or delivered for a longer period of time, to lead to measurable generalization. While M declined on some cognitive measures, it was concluded that this was due to her increasing awareness of her own errors, which reflects movement in a positive direction. Overall, intensive Schuell's stimulation approach was effective and appropriate for a participant with chronic Wernicke's aphasia, leading to improvements on trained tasks and increased participant awareness of errors; what remains to be seen are the patterns of generalization and maintenance that may emerge with a longer or modified treatment.



## **Note**

This thesis reflects a working manuscript of a project completed in collaboration with Dr. Jennifer Mozeiko. The manuscript related to this project manuscript will be submitted following final data collection and authorship will be shared by those named above.

## Introduction

### Wernicke's Aphasia

An estimated one million people in the United States are currently living with aphasia (NICD, 2015). Many can be classified under the broad labels of fluent or nonfluent aphasia, with Wernicke's aphasia being the most common fluent type (NICD, 2015). Aphasia is typically acquired as the result of a stroke, although it can also result from other injury to the language centers of the brain (ASHA, 2019). Wernicke's aphasia is specifically caused by injury to the left posterior temporal cortex, and typically manifests as difficulty understanding the meaning of language accompanied by fluent but empty connected speech. This results in the individual producing fluent but meaningless speech without being aware that they are doing so; anosognosia, or lack of awareness of errors, is a major problem in treatment of Wernicke's aphasia (Wilssens et al., 2015). People with aphasia (PWA) may sometimes communicate better via gesture, facial expression, or other nonverbal means than they do verbally (Altschuler et al., 2006). Language comprehension, reading, and writing are usually severely impaired, but often other cognitive abilities are relatively spared (National Aphasia Association, n.d.). Recovery generally occurs most rapidly in the days and weeks immediately post-onset, with gains slowing down over time (Stefaniak et al., 2019). It is generally thought that the period of spontaneous recovery covers the first year following a stroke, and that recovery slows or stops after that point, but research has indicated the time post-onset at which treatment is delivered does not necessarily correspond to a PWA's response to treatment. This is a positive prognostic indicator for those PWAs in the chronic stage of their aphasia (Moss & Nicholas, 2006). In general, it has been established that treatment can result in meaningful language outcomes for PWAs (Brady et al., 2016). Many of these outcomes are *clinically* significant, meaning that treatment resulted in

outcomes that were considered meaningful to the patient and/or provider, rather than ones that were simply *statistically* significant (Page, 2014).

One treatment variable that has received a good deal of attention is treatment intensity, which includes dose, or number of practice episodes per session; dose form, or the type of task or activity undertaken during treatment; dose frequency, or the number of treatments per day or week; and total intervention duration (Warren et al., 2007). Intensive treatment often leads to positive outcomes, but ideal intensity is unknown and may vary on a patient-by-patient basis (Brady et al., 2016; Cherney, 2012; Cherney et al., 2008; Davis & Harrington, 2006; Ramsberger & Marie, 2007; Raymer et al., 2008). Brady et al. (2016) found that while high-intensity (longer or more frequent sessions) and high-dose (more practice episodes in a session) treatment approaches appear to be more effective, these treatment groups demonstrate a higher dropout rate, indicating that treatment of this nature is not appropriate for every PWA. This is likely due to participant fatigue in addition to logistical difficulties—scheduling, transportation, etc.—involved in attending more intensive treatment. In review of the research, Cherney (2012) concluded that intensity alone does not determine effectiveness, but interacts with other variables, such as aphasia severity and nature of the treatment, in order to produce participant outcomes.

### **Treatment for Fluent/ Wernicke’s Aphasia**

A literature review reveals that few treatments have been designed and explored specifically for patients with Wernicke’s aphasia; this review also more specifically demonstrates that paucity of studies investigating the application of intensive treatment to fluent aphasia.

In an intensive treatment study using constraint-induced language therapy (CILT) and Promoting Aphasics Communicative Effectiveness (PACE), Kurland and colleagues (2010)

found improved auditory comprehension for one individual with chronic Wernicke's aphasia; Kurland et al. (2012) later produced similar results with two participants with severe nonfluent aphasia. In a study by Mozeiko et al. (2018) it was reported that for the one participant with chronic Wernicke's aphasia, progress was slower but clinically significant gains were realized and maintained following each of two treatment periods of intensive CILT. In both studies of fluent participants, PWAs showed improvement on trained items with mixed evidence of generalization to untrained items, and showed good maintenance of gains (Kurland et al., 2010; Mozeiko et al., 2018).

Other intensive treatment programs that have been used for fluent aphasia include semantic intervention, which involves using structural and semantic features to identify a target from foils. This treatment has been shown to lead to improvement in language production in one case study and one larger study ( $n = 9$ ) for participants with both Wernicke's and transcortical sensory aphasia (Davis & Harrington, 2006; Wilssens et al., 2015). Boyle (2004) found that semantic feature analysis treatment led to improvement in confrontation naming skills with generalization to untreated items, even items that were semantically unrelated to treatment items, in one patient with anomia and one with Wernicke's aphasia. It should be noted that while intensity was not a focus in Boyle's study, treatment was provided three times a week for four weeks, which some may consider intensive.

Low-frequency transcranial magnetic stimulation (LF-rTMS) paired with hour-long, one-to-one, auditory-modality-focused intensive speech-language therapy was also shown to effect improvements in spontaneous speech for participants with fluent aphasia in one study ( $n = 10$ ), although it is unclear how much of the effect is a result of the LF-rTMS, the intensive therapy, or a combination (Abo et al., 2012). In a recent study by Woodhead et al. (2017), PWAs with

Wernicke's ( $n = 11$ ) and global aphasia ( $n = 9$ ) saw improvement in speech comprehension after phonological training when the training was delivered intensively; greater gains were made by participants with more severe impairments.

Rogalski et al. (2013) tested the effectiveness of Attentive Reading and Constrained Summarisation (ARCS)—a less intensive treatment which requires participants to read aloud and summarize a passage without using nonspecific language (e.g. “thing” or “stuff”)—with two patients with chronic Wernicke's aphasia and found mixed results. Sessions averaged less than one hour, twice per week. With this less intensive ARCS treatment, one participant with moderate Wernicke's aphasia saw significant changes in both objective and self-reported measures, with generalization beyond trained items; however, a second participant with severe Wernicke's aphasia and severe anomia did not see significant gains on either type of measure. The researchers concluded that individual differences play a significant role in treatment effectiveness, and that treatment should fit the patient's specific needs (Rogalski et al., 2013).

There have been other studies of treatments for fluent aphasia in which intensity is not a central focus. A study done by Murray et al. (2004) looked at the effectiveness of Linguistic Specific Treatment (LST) for patients with different aphasia presentations, two of whom were described as “mixed” or “borderline fluent.” LST involved training verbal and written sentence production, in sessions and as homework, as well as probing auditory sentence comprehension. Results from these and other patients were mixed but generally positive, although outcomes were poorer for patients with comprehension deficits or concomitant cognitive issues. While individuals with Wernicke's aphasia are generally cognitively intact, they do usually exhibit comprehension deficits (National Aphasia Association, n.d.). This may lead to reduced effectiveness of LST for patient with this aphasia presentation.

Ramsberger and Marie (2007) found that self-directed home treatment, involving the use of computer software to create a customized cued naming program, helped one participant with Wernicke's aphasia make stable, generalizable gains in word finding, however none of the participants in the study showed good evidence of generalization to untrained items. Beeke et al. (2018) suggest, based on research involving nonfluent PWAs combined with observations of fluent PWAs, that those with Wernicke's and other forms of fluent aphasia who show awareness of errors and self-reflect on their speech may respond well to direct conversation training.

There is generally good evidence for improvement by PWAs with Wernicke's aphasia on trained language tasks and standardized assessment. Several of the aforementioned studies (Abo et al., 2012; Davis & Harrington, 2006; Kurland et al., 2010; Woodhead et al., 2017) have also found changes in participants' neurological functioning after treatment. Conclusions regarding generalization of gains, and determinations as to what severity of deficits can benefit from treatment, historically vary based on treatment type.

Overall, intensity has emerged as a key component in successful interventions for many PWAs. In one case study, Hough (1993) found that one nonfluent PWA eight months post-stroke showed gains in naming and general communication after a two-month period of twice-weekly treatment using only the visual/written modality. Like the treatment in the current study, this regimen involved adjusting treatment variables based on the patient's performance—however, in Hough's study, the patient did not make gains on auditory comprehension during this two-month period, as the auditory modality was restricted completely.

### **Schuell's Stimulation Approach**

While some prior studies focus on multiple modalities, or even restrict the auditory modality, the current study follows Schuell's (1955) framework and focuses strongly on the

auditory modality. In this framework, Schuell and colleagues argued that “strong, controlled, intensive auditory stimulation” must be a core tenant of aphasia treatment.

While language deficits in aphasia often occur across multiple modalities, the auditory modality is considered to be central to the disorder, and improving it is thought to lead to improvements in other modalities (Coelho et al., 2008). Schuell et al. (1955) reported that patients showed improvements in reading, writing, word-finding, and articulation following improvements in auditory comprehension after intensive stimulation. Similarly, Brookshire (1976) found that two patients with auditory comprehension deficits showed improvement in both speech and writing following treatment designed to target auditory comprehension. Both patients were over a year post-stroke, and their aphasia classification was not specified. One patient saw significant improvements on the Porch Index of Communicative Ability after six weeks of auditory comprehension treatment involving pointing to images in response to verbal commands. The other saw improvements on similar metrics after three months of treatment involving sentence repetition tasks and auditory comprehension tasks modified from the Revised Token Test.

Schuell et al. (1969) emphasized that PWAs need to relearn linguistic creativity and how to apply the rules of language; they do not need to be taught the words and rules themselves. The focus of her approach is not on new learning but rather on reorganization of an altered cognitive system (Martin, 1975). This approach has been supported by many studies, such as the one conducted by Wiegel-Crump and Koenigsnecht (1973). In this study, the researchers found that their four PWAs, over the course of 18 therapy sessions focusing on word-finding drills, not only showed improvement in retrieval of the 20 drilled words but also demonstrated generalization to 20 additional untrained words which they had failed to retrieve on pre-treatment testing. Wiegel-

Crump and Koenigsnecht concluded from this data that the lexical stores of PWAs are not damaged; rather, the PWAs ability to retrieve from this store is. This is consistent with Schuell's belief in relearning over learning.

Almost seventy years later, stimulation approaches remain some of the most widely employed treatments for aphasia (Coelho et al., 2008). This approach is frequently adapted by clinicians to work within the constraints under which they are operating, and to suit the individual patient(s) with whom they are working (Steele et al., 2003). Core principles of Schuell's stimulation approach (SSA) include providing a large number of stimuli and requiring the patient to make a response to each stimulus, resulting in a great number of response attempts in each session. Stimuli should be meaningful and relevant to the patient's interests, impairment, and performance, and should be varied, as the focus of treatment is reteaching skills rather than specific words. Treatment should start at the level where the patient begins to have difficulties but is not completely unable to communicate and should get increasingly difficult over time (Schuell et al., 1955). Darley (1976) adds that stimuli should be salient, unambiguous, not overly complex, and delivered at a reasonable pace with a positive attitude by the clinician. Clinicians administering SSA are discouraged from lingering on errors and encouraged to remember that patients who are unable to respond accurately may be able to respond appropriately; patient awareness of errors is not a focus in treatment. With an individual for whom error awareness is an obstacle to treatment, taking the focus off of this element may serve to make treatment more positive and encouraging and less mentally and emotionally taxing (Coelho et al., 2008). Though not necessarily always referred to as SSA, this drill type impairment-based approach is widely used among speech-language pathologists.



Given its ubiquity, the general lack of efficacious treatment options for people with Wernicke’s aphasia, and SSA’s focus on the auditory modality, testing with this treatment appears warranted. A review of the literature also finds little evidence of this type of treatment being tested for patients with Wernicke’s aphasia specifically. SSA focuses on the auditory modality, requires verbal responses, and involves massed practice—according to Schuell (1955), “the maximal number of verbal attempts should be made by the patient during each clinical period.” Unlike many other intensive treatments that are conducted in small groups, SSA is conducted on an individual basis, allowing for a more customized experience and more total repetitions of stimuli (Coelho et al., 2008). In a treatment study by Mozeiko et al. (2018), there was less generalization to untreated stimuli following CILT for PWAs with more severe aphasia. Researchers posit that this may have been due to fewer repetitions of stimuli compared to those with milder aphasia whose increased abilities allowed for quicker turn taking and an overall greater number of repetitions. Further research on other intensive treatments, such as SSA, may lead to improved clinical care for PWAs (including those with severe aphasia), who may stand to benefit from intensive treatment but not from CILT specifically.

### **The Current Study**

In the current study, a single subject design using repeated measurement of multiple behaviors was implemented to investigate the feasibility of a 30-hour SSA-based regimen for two individuals with chronic severe aphasia. Currently there is a lack of research regarding the effectiveness of SSA in treating patients with Wernicke’s aphasia, but given the empirical support for the use of intensive treatment for chronic aphasia in general (Brady et al., 2016; Cherney et al., 2008), it was hypothesized that application of SSA would be effective for both patients. While Schuell (1955) does not make specific recommendations regarding the candidacy

of persons with chronic aphasia, she does state that stimulation of the auditory modality should continue “as long as even minimal aphasic symptoms exist.”

Additionally, this study sought to explore whether a short-term 30-hour-per-week treatment regimen is feasible and effective for patients with chronic aphasia and severe auditory comprehension deficits, or if the demanding nature of treatment for this particular type of patient would lead to drop-out, as is often seen in the aphasia treatment literature (Brady et al., 2016).

There is a longstanding tradition of using both qualitative and quantitative data in aphasia research, and the current study employed a mixed-methods approach for broader and more detailed exploration of results (Damico et al., 1999; Glogowska, 2011). Quantitative research is important for statistically measuring change and calculating effect sizes in order to compare different treatments, while qualitative research can describe behavior in greater detail (Damico & Simmons-Mackie, 2003; Robey et al., 1999). The inclusion of qualitative analysis in research also supports patient- and family-focused goals of approaches like the Life Participation Approach to Aphasia by focusing on what the patient—rather than the clinician, assessor, or test creator—feels is important (Cherney et al., 2000; Dilollo & Wolter, 2004).

## **Method**

### **Participant**

The participant (M) in the current study was a 77-year-old, right-handed, native English-speaking female. She had completed 22 years of education, at the time of her stroke worked as a college professor, and lived a very active lifestyle. At the time of the study M was living at home with her husband and had daily contact with her adult daughter, L. She was 30.5 months post onset of an ischemic cerebrovascular accident (CVA) of the left middle cerebral artery confirmed

by MRI. She presented with severe fluent aphasia, with a score of 31 on the WAB-R-AQ and a resulting classification of Wernicke's aphasia. She demonstrated both receptive and expressive language deficits characterized by frequent perseveration, poor awareness of errors, and frequent use of neologisms. At the outset of the study she demonstrated poor ability to follow simple directions, and her repetition of both language and gesture was inconsistent. Her reading and writing skills were both well-preserved compared to her auditory-verbal skills but were still extremely variable. She demonstrated no motor or vision deficits.

M received no outside therapy during the course of treatment and was asked to discontinue use of her Constant Therapy app, but she did continue attending weekly Language Support groups.

### **Experimental Design**

This study used a single subject design with repeated measures to assess the effect of 30 hours of treatment (3 hours/day every weekday for two weeks) on a person with chronic, severe Wernicke's aphasia. Baseline probes were each administered at least three times prior to the start in order to assess for stability of behaviors. Probes were also administered every other day of treatment, immediately post treatment, and five- and 10-weeks post treatment. Standardized assessments and self-rating scales were administered pre-, immediately post-, five weeks, and 10 weeks post-treatment.

### **Standardized Assessments**

Baseline assessments were administered the week prior to the start of treatment. Follow-up assessments were administered one, five, and 10 weeks post-treatment. Assessments included the Western Aphasia Battery – Revised – Aphasia Quotient (WAB-R-AQ) (Kertesz, 2006), the Boston Naming Test (BNT) (Kaplan et al., 2001), Raven's Coloured Progressive Matrices

(RCPM) (Raven et al., 1986), the Auditory Comprehension Test for Sentences (ACTS) (Shewan, 1979), and the Cognitive Linguistic Quick Test (CLQT) (Helm-Estabrooks, 2001). Only tasks one (map search), two (elevator counting), and six (telephone search) of the Test of Everyday Attention (TEA) (Ridgeway, et al., 1994) were attempted, as it was determined at baseline that M's auditory comprehension was too poor to follow the directions of the other tasks; she was unable to complete the tasks as directed even with multiple presentations of the directions and testing materials, and it was determined that her difficulty with the language in the instructions prevented an accurate assessment of her cognitive abilities with these tasks.

At baseline and 10-week follow-up, L filled out the Communicative Effectiveness Index (CETI) for M (Lomas et al., 1989). This was done in order to assess stimulus generalization, defined by Thompson (2006) as “changes in untrained language conditions,” and to evaluate changes in M's functional communicative abilities in situations outside the clinic, as perceived by one of her primary communication partners. See Appendix A for a list of CETI questions.

### **Probing Schedule**

Probes were administered to track trends and behavioral variability in trained and untrained stimuli and contexts, and to look for evidence of generalization in untrained stimuli and contexts (Thompson, 2006). Probes of expressive and receptive language were administered every day during baseline, treatment, and follow-up. Picture naming and narrative discourse served as probes of expressive language. To probe receptive language, M was tested on single-step directions. Trained naming probes, untrained naming probes, and discourse production probes were given every day during baseline and follow-up. Trained naming probes were given every day during treatment, while untrained naming probes and discourse production probes were given three and five times during treatment, respectively. All probes were given at the start

of the session to avoid effects of fatigue, and no specific feedback or cueing was provided, although general encouragement was provided to avoid frustration.

### **Picture Naming Probes**

In picture naming probes, M was shown a photograph from the naming stimuli and prompted with “This is a/n \_\_\_\_.” For both probes and treatment, color photographs of high-frequency nouns were used. Forty trained and 20 untrained pictures were used. A complete list of stimuli and their Kučera-Francis written frequency (KKFRQ) can be found in Appendix B (Kučera & Francis, 1967).

After the start of treatment, M quickly learned the task and did not need the carrier phrase. A response was considered correct if it consisted of a correct, intelligible verbal response. Incorrect plural forms were considered correct, i.e. “sock” and “socks” were both marked as correct. Paraphasias were marked as correct if the intended word was unambiguous, i.e. “jipper” was accepted for “zipper” as it could not be confused with another word, but “tan” was not accepted for “fan” as “tan” is a real word that is different from the target.

Throughout treatment M appeared to have more success with sentence completion prompts than with cold naming prompts, so these were incorporated into both probing and treatment to track whether accuracy remained consistently high. Sentence completion probes consisted of the student clinician presenting the naming stimuli (trained and untrained) preceded by a contextual carrier phrase (ex. “I have a flat \_\_\_\_”). Correct and incorrect responses were judged in the same manner as other naming probes.

### **Discourse Probes**

Discourse production was not treated but probed to assess for response generalization as is recommended for single subject design studies (Thompson, 2006). M was given three random

Norman Rockwell images (out of 12 total), one at a time, and was prompted with, “Tell me what’s happening in this picture.” The participant’s press of speech necessitated providing her with a two-minute time limit to respond. Responses were timed and recorded. All responses were later transcribed and analyzed for rate, word count (WC), and correct information units (CIUs), defined as words that are “accurate, relevant, and informative relative to the eliciting stimulus” (Nicholas & Brookshire, 1993).

### **One-Step Direction Probes**

Auditory comprehension was initially probed by asking M to point to a named picture, but due to high accuracy (96.67%) on the first day of baseline, this type of probe was discontinued. Instead, M was probed on her ability to respond to single-step directions. Some involved manipulating the trained pictures from Picture Naming (ex. “Put the pig on top of the shoe”) while others consisted of responses unrelated to the photographs (ex. “Point to the door”). One-step directions were probed daily and trained during treatment.

### **Treatment for Auditory Comprehension and Oral-Verbal Production**

The framework for SSA is well described in Coelho, Sinotte, and Duffy (2008). Tasks taken from this framework, explained in more detail later, included Point-To, Following Directions, Yes-No Questions, Sentence or Phrase Completion, and Self-Initiated Verbal Tasks; elements of Response Switching and Repetition were also employed. Tasks were presented in such a way as to work M near maximum capacity without causing excessive stress or frustration. This was done by adjusting difficulty to maintain response accuracy of around 60-80%. Attempts were made to start and end each treatment block with easier tasks in order to facilitate a positive attitude. Errorless learning, as discussed by Fillingham et al. (2003) was applied; M was not transitioned to the next stimuli until an appropriate response had been produced for the current

stimuli, to avoid reinforcing error responses. Due to the fact that she was sometimes observed to produce a correct response after a perseverated response, and sometimes demonstrated awareness that a perseverated response was incorrect, error reduction rather than error elimination was applied.

Treatment was provided for two weeks, for three hours every weekday, for a total of 30 hours spread evenly across 10 sessions. Each session was divided into two 90-minute treatment blocks with approximately 15 minutes of break time in between. The first treatment block consisted of auditory comprehension tasks, including pointing to named photographs (“Point to the shark,”) pointing to a photograph by function or quality (“Point to the one that lives in the ocean,”) and pointing to a group of photographs by category (“Point to all of the animals.”). A field of 4-10 cards was used depending M’s success rate and the number of cards that the student clinician determined needed more repetitions. The starting field was generally six cards; this number was increased if M’s success rate was high (around 80% or higher) after several rounds or when reviewing items M had previously gotten correct, and decreased if M’s success rate was low (around 50% or less) or when reviewing items with which she struggled. M needed little cueing during these tasks; her accuracy was high and she often self-corrected. When she did need cueing, repeating the initial prompt was often sufficient to encourage her to reevaluate and correct her response. When more cueing was required, the student clinician went item-by-item, using item names, to re-prompt the participant (“Does a tire live in the ocean? Does a shark live in the ocean?”).

Other auditory comprehension tasks included following directions and answering yes/no questions. M practiced two types of trained directions: those that involved the photographs (e.g., “Turn the truck upside down”) and those that did not (e.g. “Put your hands on your shoulders”).

Cueing involved repetition of the original direction—this often allowed M to realize she had given a wrong response—repetition of a key word, use of a related phrase (ex. “Close your eyes” would be followed by “When I go to sleep, I close my eyes”), and finally a repetition of the direction accompanied by a model of the correct action by the student clinician.

During yes/no questions, M was preemptively provided with a visual cue in the form of a paper with “Yes” and “No” printed on it. The student clinician asked objective questions, such as “Are you wearing a hat?” or “Is it December?” If M provided any response other than a verbal “yes” or “no”—pointing, head shake, longer phrases, etc.—the student clinician prompted her to respond with a verbal “yes” or “no” by pointing to the visual aid, giving a verbal reminder, or both. If M answered incorrectly, cues were provided in the form of repeating the question, rephrasing the question, asking a related question, and finally providing the correct answer and then repeating the question until M provided the correct verbal response.

In the second 90-minute block, verbal production was targeted. In these tasks, M was presented with the 40 photographs, one at a time. One task involved prompting solely with “This is a(n) \_\_\_\_.” A second task involved providing a contextual carrier phrase such as “I have a flat \_\_\_\_.” A third task involved giving a clue about the target word without using sentence completion, such as “I have these on my car.” For each task, the student clinician gave M a few seconds to respond on her own, but if M did not respond, or became perseverative, the student clinician provided the first sound of the target word. If M’s difficulties persisted, the student clinician provided more of the word, up to and including providing the whole word for M to repeat. M was encouraged to repeat accurate responses multiple times in order to reinforce the correct words.



## **Data Analysis**

The data from the current mixed-methods research were analyzed both qualitatively and quantitatively. The mixed-methods design was utilized in order to enhance study validity by providing two perspectives on the data. Additionally, both aphasia and its treatment are extremely heterogenous, and one method of analysis is not sufficient to study the entire scope of the disorder and recovery (Glogowska, 2011; Hula et al., 2010; Thompson, 2006).

Intrarater reliability was ensured for naming and one-step direction probe responses by recording M's responses to probes (both with an audio recorder and in writing) for later review to ensure that consistent criteria were applied to determine the correctness of a response. Interrater reliability was ensured for discourse probe transcription by having a second rater unfamiliar with M review the audio recordings and transcriptions of the first rater. Intra- and interrater reliability were ensured for standardized tests by comparing and discussing the scoring of each test each time it was administered.

## **Comparison to 2017 Study**

M's results were compared to those of P, an individual with nonfluent aphasia who participated in similar treatment in 2017. P was a 60-year-old, right-handed, native English-speaking male with 17 years of education. At the beginning of the study he was 16 months post-onset of a large CVA. He presented with severe nonfluent isolation aphasia with a baseline WAB-R-AQ of 29.2. He had both receptive and expressive language deficits, poor awareness of errors, some overlearned words and phrases, perseverations, and difficulties with basic commands, although his repetition was relatively preserved (Hughes, 2017).

The 2017 study also used a single subject design with repeated measures, as well as the same independent and dependent variables as the current study. The framework, dosage, and use

of Schuell's stimulation were identical (Hughes, 2017). Treatment fidelity was ensured during the current study by maintaining the same treatment and follow-up schedule, using the same materials, and having the same investigator supervise to ensure consistency. A complete list of stimuli from both studies can be found in Appendix B.

Tasks were structured similarly, but difficulty levels and cueing hierarchies were tailored to fit each participant, as recommended for SSA (Coelho et al., 2008). Data analysis was conducted in the same way for both the 2017 study and the current study, and effect sizes were compared (Hughes, 2017).

## **Results**

### **Naming Probes**

Analysis of probed data consisted of both visual inspection of the data and measurement of effect sizes (Robey et al., 1999). Effect size (ES) was calculated following the formula outlined by Bailey et al. (2015): the three baseline and two posttreatment probe measures were averaged, then the baseline average was subtracted from the posttreatment average. This new value was divided by the standard deviation (SD) of the baseline probes to determine the ES for each area. ES's were identified as small (4.0-6.9), moderate (7.0-10.0), or large (10.1+) (Beeson & Robey, 2006). ES's calculated for M's performance on untreated items was used as a measure of generalization.

Figures 1 and 2 illustrate M's accuracy on trained and untrained naming probes, shown as percentage of items correct. Visual inspection of the data indicated an improvement in trained naming probes and no change in untrained naming probes. Immediately posttreatment, trained naming probes had an ES of 23.100, which is large, and untrained naming probes had an ES of 0,

which indicates no change. At the 10-week follow-up, trained naming probes had an ES of 17.442, which is large, and untrained naming probes had an ES of 0, which indicates no change.

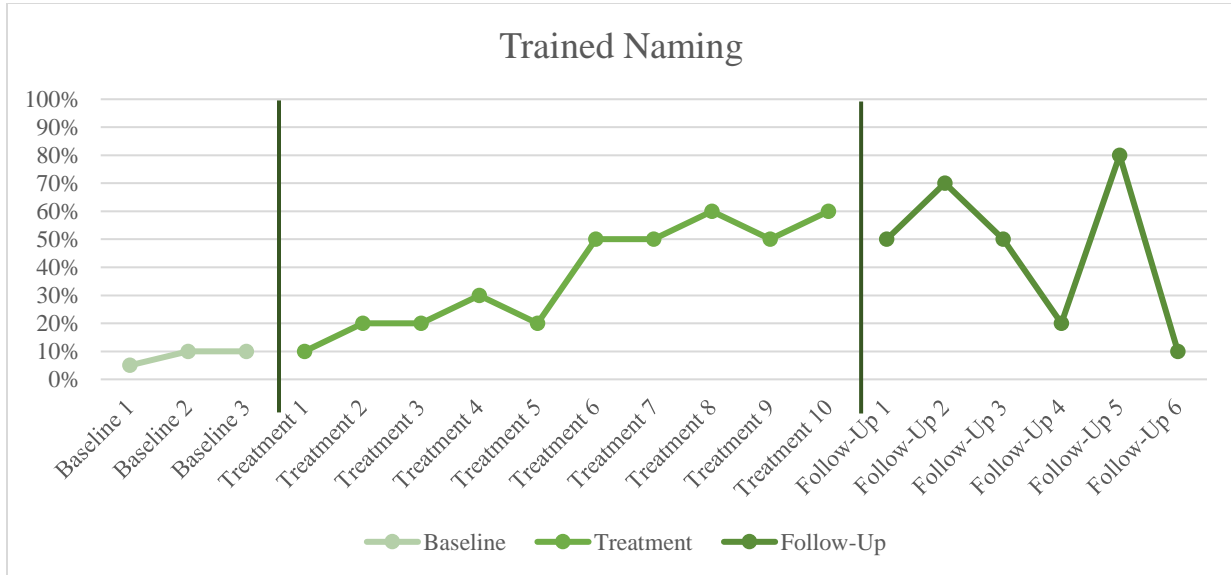


Figure 1. Percent accuracy on trained naming probes.

Note: All trained probes were administered daily. For all probes, two follow-up probes were taken immediately post treatment, two were five weeks post-treatment, two were 10 weeks post-treatment.

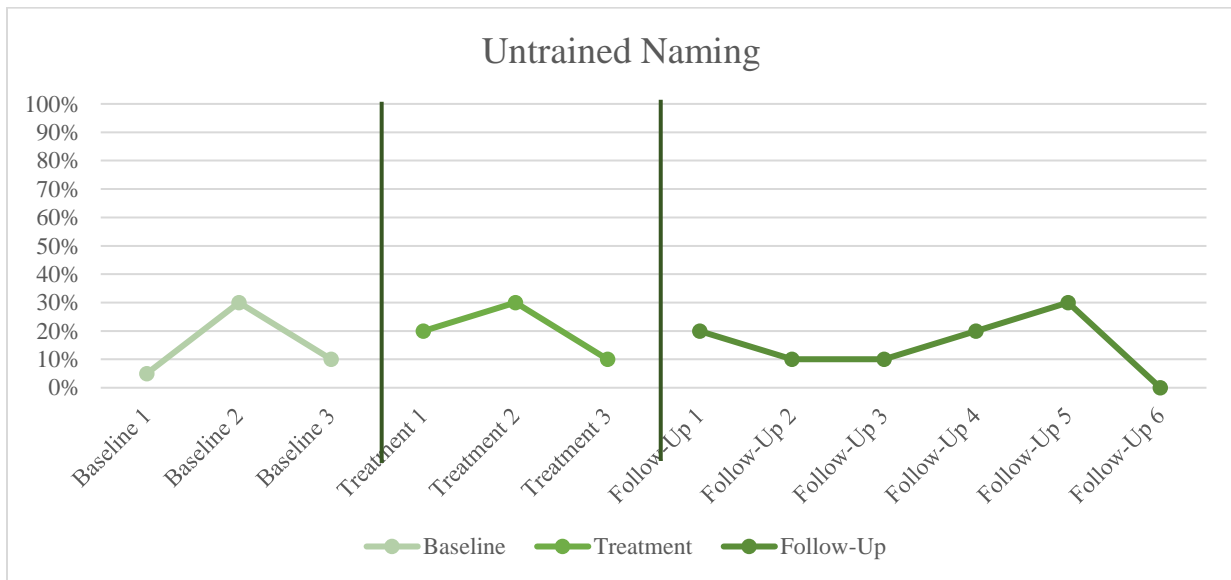
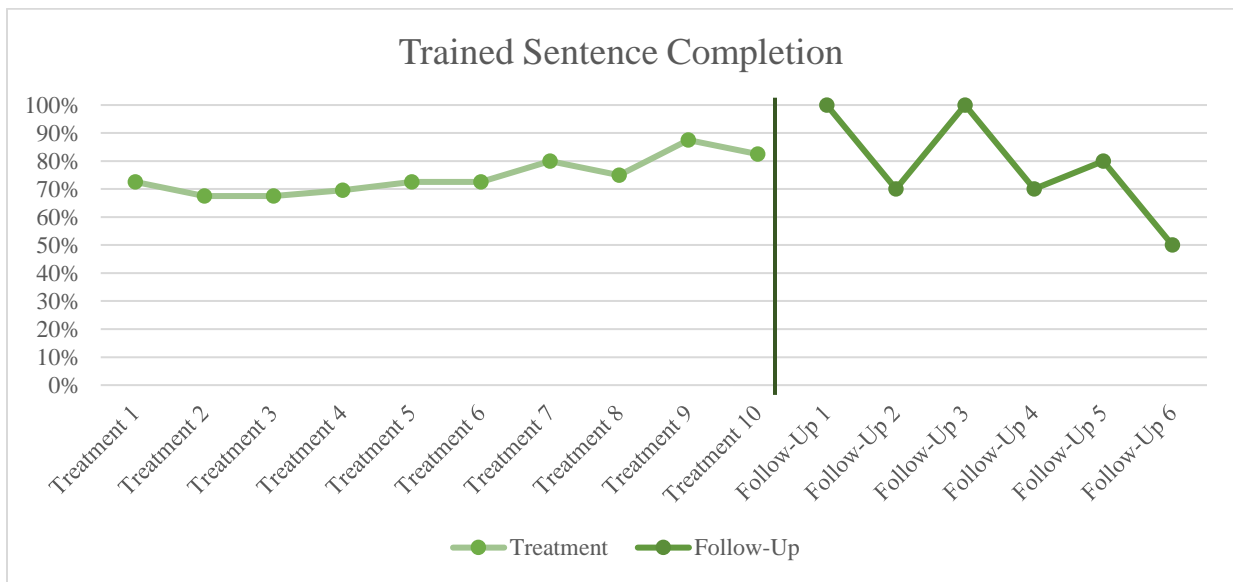


Figure 2. Percent accuracy on untrained naming probes.

Note: Untrained naming probes were provided every other day starting on third day of treatment.

Throughout treatment, M consistently demonstrated more success with sentence completion prompts than with picture naming prompts. Data were retrospectively taken from audio recordings and sentence completion with trained items was probed at baseline in order to determine if her accuracy remained consistently high throughout the study. These results are illustrated in Figure 3.



*Figure 3.* Percent accuracy on sentence completion tasks.  
*Note:* Only the first presentation of each word was evaluated.

Overall, M’s accuracy remained high during the sentence completion naming task for the trained items. Untrained items were not probed for sentence completion during treatment but were probed at follow-up; M’s accuracy on this task was 21.67% on average, with a range of 10-40%, indicating some generalization from trained to untrained items on this task; this represents better generalization than the probed tasks.

**One-Step Direction Probes**

Figures 4 and 5 illustrate M’s accuracy on trained and untrained one-step directions, shown as percentage of items correct. Visual inspection of the data indicated an improvement in

trained one-step directions and no change bordering on slight decline in untrained one-step directions. ES for these measures was unable to be calculated using the method prescribed by Bailey et al. (2015) due to the SD of both baselines equalling 0. Therefore, the ES was calculated using Bailey et al’s (2015) formula, but using the pre-treatment SD from other probe measures (in this case, the trained and untrained naming probes) as recommended by Beeson and Robey (2006). Immediately posttreatment, trained one-step direction probes had an ES of 18.562, which is large, and untrained one-step direction probes had an ES of -1.157, which indicates no change. At the 10-week follow-up, trained one-step direction probes had an ES of 15.910, which is large, and untrained one-step direction probes had an ES of 0.046, which indicates no change.

Initially, one-step directions requiring verbal responses (ex. “Name a color” or “Say your name”) were included in treatment and probing. However, it was determined that increased linguistic demands of these instructions made them unreasonably difficult compared to the non-verbal instructions, and they were subsequently removed from the data. These verbal commands can be found in Appendix B.



Figure 4. Percent accuracy on trained one-step direction probes.

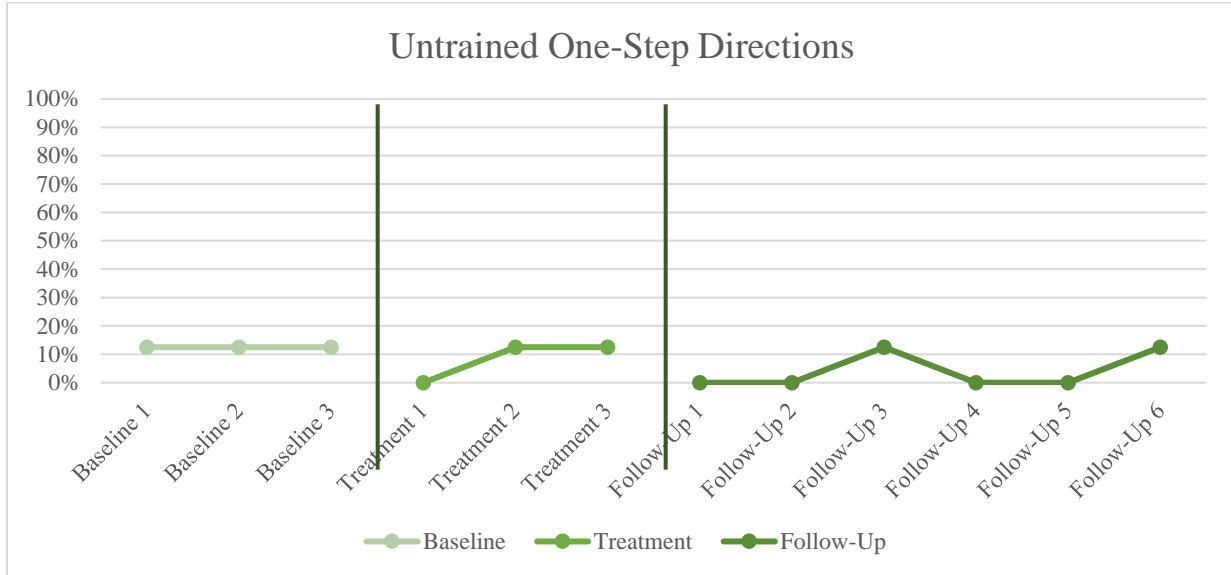


Figure 5. Percent accuracy on untrained one-step direction probes.  
 Note: These probes were administered every third day of treatment.

Effect sizes are summarized in Table 1.

Table 1: Summary of effect sizes.

Measure	Effect Size		Descriptor
	Immediately Posttreatment (1 week)	Follow-Up 3 (10 weeks)	
<b>Trained Naming</b>	23.100	17.442	Large
<b>Untrained Naming</b>	0	0	None
<b>Trained One-Step Directions</b>	18.562	15.910	Large
<b>Untrained One-Step Directions</b>	-1.157	0.046	None

Note: A small ES was defined as 4.0-6.9, moderate ES as 7.0-10.0, and large ES as 10.1+ (Beeson & Robey, 2006).

On the above probe measures, M showed either improvement or no change; she did not show significant decline on any measure.

### Discourse Probes

For discourse, M's total number of intelligible words and total number of CIUs were calculated using rules outlined by Nicholas and Brookshire (1993). From here, discourse

efficiency (defined as CIUs per minute) and informativeness (defined as the ratio of CIUS to total words) were measured. Productions were transcribed by the student clinician, and transcription reliability was ensured by having a third party unfamiliar with the subject verify the transcriptions. Table 2 outlines the major parameters by which M’s discourse production was measured.

It should be noted that, due to a recording error, only one of M’s responses on the first day of baseline was captured. In order to maintain a baseline of nine samples, she was given two more discourse probes on the first day of treatment before any other probes or treatment.

*Table 2: Discourse probes.*

	Minutes	Words	Words/Min	CIUs	CIUs/Min	CIUs/Words
<b>Baseline 2</b>	1.87	240.00	128.34	19.33	10.34	0.08
<b>Baseline 3</b>	1.86	270.00	145.16	28.67	15.41	0.11
<b>Baseline 4</b>	1.43	182.00	127.27	19.00	13.29	0.10
<b>Treatment 1</b>	1.47	194.33	132.19	13.33	9.07	0.07
<b>Treatment 2</b>	1.74	207.00	118.97	15.67	9.01	0.08
<b>Treatment 3</b>	1.34	154.00	114.93	20.00	14.93	0.13
<b>Treatment 4</b>	1.32	156.67	118.69	5.67	4.30	0.04
<b>Treatment 5</b>	1.17	138.67	118.52	7.33	6.26	0.05
<b>Follow-Up 1 (1 week)</b>	1.42	178.67	125.82	11.00	7.75	0.06
<b>Follow-Up 2 (5 weeks)</b>	1.40	189.17	135.12	8.83	6.31	0.05
<b>Follow-Up 3 (10 weeks)</b>	1.26	185.33	147.09	22.67	18.00	0.12

*Note:* Baseline 1 was not calculable due to a recording error. Words are intelligible words; CIUs are correct information units, or relevant and informative words. Efficiency is measured in CIUs/min, while informativeness is measured in CIUs/words.

Visual inspection of the data shows that the amount of time M spent on discourse probes decreased slightly over time, while her words per minute stayed about the same. Her efficiency, measured in ratio of CIUs to words, was low to begin with and decreased slightly before demonstrating a substantial increase at the 10-week follow-up. Her informativeness followed a similar pattern of slight decline followed by a substantial jump at the 10-week follow-up.

Point-to-point comparison within a sample of five discourse transcriptions was completed using the following formula to determine percent difference, where  $V_1$  corresponds to the first

number of CIUs (either first pass or first rater) and  $V_2$  corresponds to the second number (either second pass or second rater):

$$\frac{|V_1 - V_2|}{\frac{(V_1 + V_2)}{2}} \times 100$$

Percent difference was then subtracted from 100 in order to determine percent reliability. For CIU count, intrarater reliability was 74.81%, while interrater reliability was 59.57%; these low figures were attributed to M's press of speech, her frequent perseverations, and ambiguity inherent in her fluent but often meaningless speech. Differences in interrater reliability were resolved via discussion.

### **Standardized Assessment**

Table 3 shows M's scores on standardized assessment measures. On the WAB-R-AQ, a difference of five points in either direction has historically been considered clinically significant, although it has been found that the standard error of measurement (SEM) is <2 points for scores between 30-70, and >6 for scores below 20 or over 90 (Gilmore et al., 2019; Hula et al., 2010); both criteria were considered when evaluating change on the WAB-R-AQ. On all other tests, a change of 20% or more was considered clinically significant, to replicate the method used in the 2017 study (Hughes, 2017; Ramsberger & Marie, 2007).

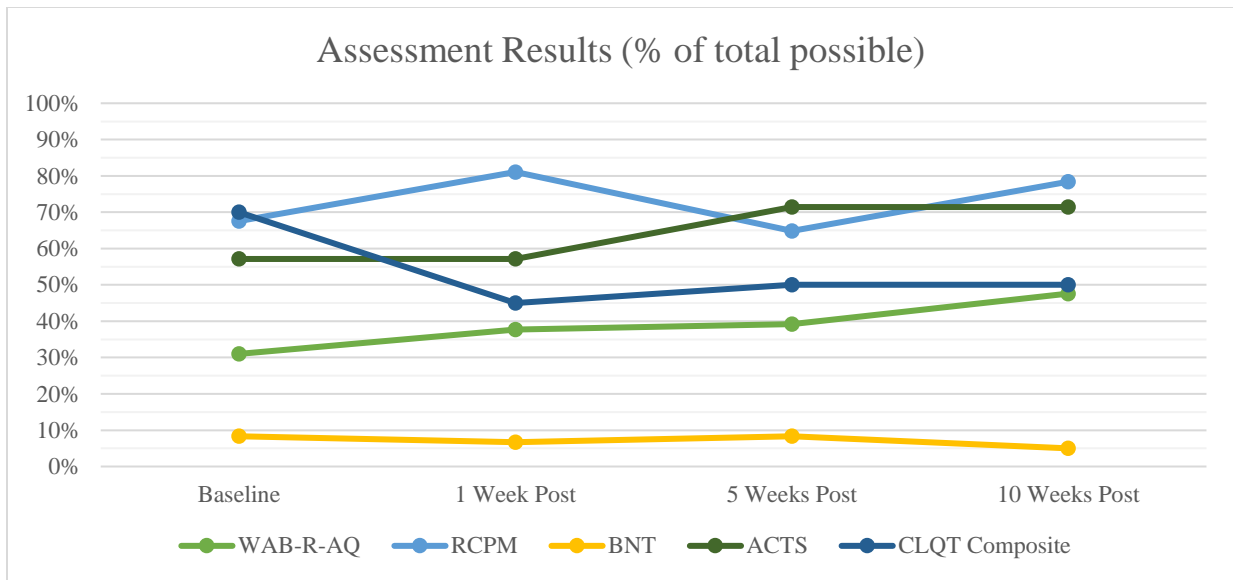


Table 3: Summary of assessment data.

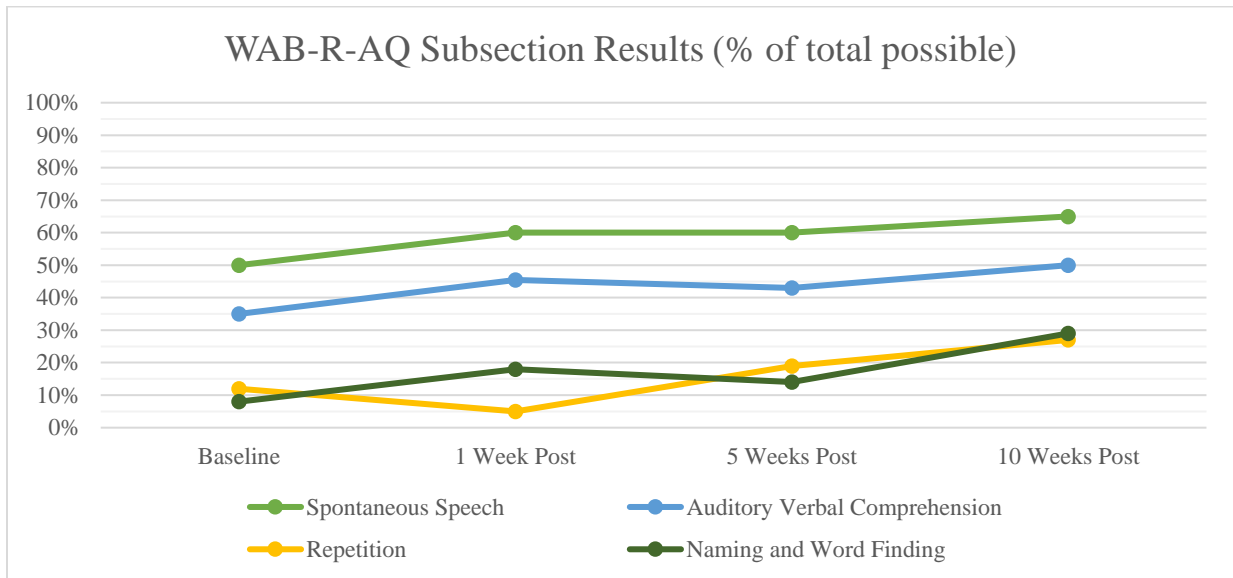
Assessment	Baseline	Posttreatment (1 week)	Follow-Up (5 weeks)	Follow-Up (10 weeks)
<b>WAB-R-AQ</b>	31	37.7*	39.2	47.6* <sup>†</sup>
<b>RCPM</b>	25	30*	24*	29*
<b>BNT</b>	5	4*	5*	3* <sup>†</sup>
<b>ACTS</b>	12	12	15*	15 <sup>†</sup>
<b>CLQT – composite</b>	2.8	1.8*	2.0	2.0 <sup>†</sup>
<b>TEA – map search 2</b>	7	3*	7*	3* <sup>†</sup>
<b>TEA – elevator counting</b>	3	7*	3*	3
<b>TEA – telephone search</b>	1	1	1	1

Note: A \* represent clinically significant change from the previous value. A <sup>†</sup> represents clinically significant change from baseline to the 10-week follow-up. WAB-R-AQ = Western Aphasia Battery-Revised Aphasia Quotient, RCPM = Raven’s Progressive Matrices, BNT = Boston Naming Test, ACTS = Auditory Comprehension Test for Sentences, CLQT = Cognitive Linguistic Quick Test, and TEA = Test of Everyday Attention.

M’s scores on the WAB-R-AQ showed clinically significant improvement from baseline to immediately posttreatment, from the five-week to the 10-week follow-up, and from baseline to the 10-week follow-up, even using the more conservative five points as an indicator of clinical significance. Her score on the RCPM demonstrated clinically significant improvement immediately posttreatment but declined slightly during the follow-up period, and her 10-week follow-up score fell just short of 20% improvement from her baseline score. Her score on the BNT showed clinically significant decline immediately posttreatment and never improved above baseline. Her score on the ACTS did not immediately show improvement posttreatment but demonstrated clinically significant improvement from baseline at both the 5- and 10-week follow-ups. On the TEA, her Map Search 2 score showed decline and her Elevator Counting score showed improvement immediately posttreatment, but by the end of the follow-up period all TEA scores had either remained at or dropped below baseline levels. Graphical representations of these results are shown in Figures 6 and 7.



**Figure 6.** Summary of assessment results as a percentage of total possible score.  
*Note:* The Test of Everyday Attention is not included due to scoring being broken into multiple subsections. WAB-R-AQ = Western Aphasia Battery-Revised Aphasia Quotient, RCPM = Raven’s Progressive Matrices, BNT = Boston Naming Test, ACTS = Auditory Comprehension Test for Sentences, and CLQT = Cognitive Linguistic Quick Test.



**Figure 7.** Breakdown of WAB-R-AQ (Western Aphasia Battery-Revised Aphasia Quotient) results by subsection as a percentage of total possible score.

**Communicative Effectiveness Index (CETI)**

The CETI was completed both times by M’s adult daughter, L. Each time, L completed the CETI by making marks on a 10.5-centimeter line to indicate her perception of M’s abilities at

the time of assessment compared to her abilities pre-stroke. See Appendix A for the full CETI form.

Results on the CETI were calculated by measuring the distance along the line (in mm) at which L marked her scores and comparing scores at baseline and follow-up (Lomas et al., 1989). As with the standardized tests, a change of 20% or greater was considered clinically significant (Ramsberger & Marie, 2007). Table 4 depicts a comparison of the results of the CETI from baseline to the 10-week follow-up.

*Table 4: Summary of CETI (Communicative Effectiveness Index) data.*

Item	Baseline	Follow-Up (10 weeks)	Change
Getting somebody's attention.	10.50 cm	7.95 cm	-2.55 cm
Getting involved in group conversations that are about him/her.	9.60 cm	7.95 cm	-1.65 cm
Giving yes and no answers appropriately.	5.45 cm	5.05 cm	-0.40 cm
Communicating his/her emotions.	7.55 cm	8.60 cm	+1.05 cm
Indicating that he/she understands what is being said to him/her.	5.70 cm	8.15 cm	+2.45 cm
Having coffee-time visits and conversations with friends and neighbors (around the bedside or at home).	2.80 cm	8.30 cm	+5.50 cm
Having a one-to-one conversation with you.	10.30 cm	9.55 cm	-0.75 cm
Saying the name of someone whose face is in front of him/her.	1.05 cm	2.70 cm	+1.65 cm
Communicating physical problems such as aches and pains.	8.95 cm	9.30 cm	+0.35 cm
Having a spontaneous conversation (i.e. starting the conversation and/or changing the subject).	9.65 cm	9.35 cm	-0.30 cm
Responding to or communicating anything (including yes or no) without words.	9.65 cm	8.10 cm	-1.55 cm
Starting a conversation with people who are not close family.	5.65 cm	8.35 cm	+2.70 cm
Understanding writing.	5.80 cm	4.90 cm	-0.90 cm
Being part of a conversation when it is fast and there are a number of people involved.	10.00 cm	8.60 cm	-1.40 cm
Participating in conversations with strangers.	6.00 cm	9.50 cm	+3.50 cm
Describing or discussing something in depth.	9.60 cm	2.95 cm	-6.65 cm

*Note:* Green indicates clinically significant positive change, while orange indicates clinically significant negative change.

For the majority of items, L's ratings at the 10-week follow-up indicated significant improvement or no change in M. The only two items that indicated clinically significant decline were: 1) Getting somebody's attention and 16) Describing or discussing something in depth.

### **Qualitative Observations**

Glogowska (2011) discusses the need for both quantitative and qualitative data reporting in healthcare research, and many modern aphasia approaches, such as the Life Participation Approach to Aphasia, focus heavily on participants' quality of life and ability to participate in daily activities in a meaningful way (Chapey et al., 2000). In keeping with these principles, qualitative observations were noted by the student clinician throughout baseline, treatment, and follow-up, and qualitative comments were noted when they came from participants' significant others. In discussions with the participant and her daughter, L reported noticing an improvement in M's ability to get her point across, and noted that M was very eager to participate in treatment and testing throughout the entire course of the study, going so far as to rehearse probe and treatment items as she went about her day-to-day life. M herself always indicated a positive attitude about treatment and did not indicate a desire to stop or pause at any point, even when frustrated. During treatment and follow-up testing, the student clinician noted longer and more relevant spontaneous speech from M, as well as an increased awareness of her own errors.

### **Comparison to 2017 Results**

Tables 5 and 6 outline major comparisons between M and P's results. Both were evaluated using the same metrics except for the comprehension probes, the TEA, and the CETI. M's comprehension was evaluated using trained and untrained one-step direction probes, while P's comprehension was evaluated using single-word picture identification probes. M was given the CETI and four subtests of the TEA, while P was not given either measure (Hughes, 2017).

Regarding discourse probes, due to differences in aphasia presentation and language behaviors, P was probed for discourse every day during baseline, treatment, and follow-up, was not given a time limit for these discourse probes, and was given a repeated prompt or “Is there anything else?” if needed. As with M, P received all probes at the beginning of treatment, and received no feedback or cueing (Hughes, 2017).

Table 5: Comparison of results of 2017 and current study.

Assessment	M (2019)	P (2017)
<b>Trained Naming Probes</b>	Clinically significant improvement	
<b>Trained Comprehension Probes</b>	Clinically significant improvement	
<b>Untrained Naming Probes</b>	No change	Clinically significant improvement
<b>Untrained Comprehension Probes</b>	No change	Clinically significant improvement
<b>Discourse Probes</b>	Responses were shorter; efficiency (ratio of CIUs to total words) did not improve.	Responses were longer; efficiency did not improve.
<b>WAB-R-AQ</b>	Clinically significant improvement	
<b>RCPM</b>	Clinically significant improvement	
<b>BNT</b>	Significant decline	Clinically significant improvement
<b>ACTS</b>	Significant improvement	Clinically significant improvement initially following treatment which dropped off severely at 10 weeks
<b>CLQT</b>	Significant decline	No change
<b>TEA</b>	All subtests either maintained or declined.	N/A
<b>CETI</b>	Significant improvement on 5/16 items; significant decline on 2/16.	N/A
<b>Qualitative Observations</b>	Overall Improvement - Continued enthusiasm for treatment, longer and more relevant spontaneous speech, increased awareness of errors.	Overall Improvement - Better attention, reduced verbal perseveration, decreased impulsivity, more relevant responses.

*Note:* Similarities between participants are highlighted in blue and differences are highlighted in orange. Improvements are across all time points except when noted otherwise. WAB-R-AQ = Western Aphasia Battery-Revised Aphasia Quotient, RCPM = Raven’s Progressive Matrices, BNT = Boston Naming Test, ACTS = Auditory Comprehension Test for Sentences, CLQT = Cognitive Linguistic Quick Test, TEA = Test of Everyday Attention, and CETI = Communicative Effectiveness Index.

Both participants demonstrated positive changes with a large ES for trained production probes, and a clinically significant change for trained comprehension probes. While P showed a small effect size for both types of untrained probes, M showed no change or a decline in performance. Both participants' discourse responses moved away from the typical length expected for their aphasia presentation (M's became shorter while P's became longer), but neither showed significant improvement in productivity as measured by CIUs per number of words, except for M at the 10-week follow-up.

Researchers in Hughes' (2017) study noted that P demonstrated improved attention and reduced impulsivity and verbal perseveration over the course of treatment; caregivers and others noticed these changes as well as an improvements in the relevance of P's verbal responses. In the current study, M's communication was described by family members as more effective after treatment, and researchers noticed improved spontaneous speech and increased self-awareness of errors. Overall, qualitative results support improvement in quality of life and outsiders' perceptions of their speech for both participants.

## **Discussion**

In this study, we sought to examine whether individuals with chronic aphasia (both fluent and nonfluent type) could make gains in receptive and expressive language following intensive SSA, even if those individuals had ceased to make gains with traditional speech therapy. SSA is based on providing the patient with an abundance of auditory stimulation in order to facilitate neuroplastic change (Schuell, 1955; Coelho, 2008). The current study was based on the framework outlined by Coelho et al. (2008) for an individual with severe fluent aphasia. Results

were compared to those of a participant with severe nonfluent aphasia (Hughes, 2017). We tested the efficacy of SSA for two different aphasia types.

In both studies, participants received 30 hours of treatment, distributed evenly across 10 consecutive weekdays. The added intensity component was expected to contribute to the effectiveness of this treatment, given the finding that greater intensity often leads to better outcomes in aphasia treatment (Brady et al., 2016). In this study, we also investigated whether this short-term intensive treatment regimen is feasible (i.e. reasonable for patients to complete without drop-out) for people with such poor receptive language and effective (i.e. shows improvements in receptive and expressive language, as well as generalization of skills) for patients with chronic aphasia.

### **The Current Study (M) – Quantitative Results**

The participant in the 2019 study, M, was chosen for this study due to the chronic, fluent nature of her aphasia, as well as her motivation to seek treatment and general positive attitude. As drop-out tends to be a problem associated with more intensive aphasia treatment, choosing an individual with high motivation and an optimistic view of treatment was intended to help ensure treatment would be completed (Brady et al., 2016). On the other hand, if a highly motivated individual was unable to complete treatment, it could be expected that individuals with similar severity of deficits but lower motivation would have even more difficulty with such an intensive treatment regimen.

During baseline testing, M's receptive language, though poor, was shown to be stronger than her oral-verbal expressive language, and measures of single-word comprehension were removed from the probing schedule due to high accuracy on the first day. These probes were replaced with one-step direction probes, which proved to be sufficiently challenging for M. Throughout

the study, she was sometimes able to perform multiple directions consecutively with no cueing; however, she struggled to switch between types of directions, i.e. from interacting with the stimuli photographs to producing responses that did not involve the photographs. From baseline to the follow-up period, M's performance on trained one-step directions improved significantly, but this improvement did not generalize to untrained one-step directions. Given that patients with Wernicke's aphasia often struggle with comprehension and awareness of errors, it may be that the combined comprehension and self-awareness demands placed on M by the one-step directions task made generalization difficult; she not only needed to understand the directions, but there was the added cognitive hurdle of being aware of her own mistakes (National Aphasia Association, n.d.; Wilssens et al., 2015). It is also possible that she did not have enough practice with this type of task. The graduate student clinician also noted that M's responses to yes/no questions appeared less random and more accurate and meaningful as treatment progressed.

M's performance on trained verbal naming probes improved significantly from baseline to the follow-up period. Her performance on untrained verbal naming (i.e. naming stimuli that were not used during treatment) stayed consistently low. The graduate student clinician observed that M's naming performance was highest when completing sentences, such as "I have a flat \_\_\_\_" and lowest when naming an item from a photograph paired with a description, such as "It's made of rubber and goes on your car," and this finding was reinforced by data showing M's consistently higher accuracy in naming items when presented with a contextual carrier phrase. This is consistent with a previous study showing that for patients with various types of aphasia, the use of a carrier phrase is a good response facilitator, while the use of a description is a weaker one (Barton et al., 1969). The authors in this prior study concluded that sentence completion provided the greatest opportunity for automatic answers from the person being



tested. For M, it is not surprising that highly learned items elicited in familiar and therefore more automatic contexts were the easiest to produce and showed the greatest generalization, and that naming tasks or tasks involving less trained items (even when tasks were highly contextualized) were more difficult.

M's efficiency (intelligible words per minute) on discourse measures did not appear to improve from baseline to follow-up. Over the course of treatment and follow-up, she spent less time on average on each task, her words per second stayed roughly the same, and her efficiency (CIUS per minute) and informativeness (ratio of CIUs to total words) both decreased slightly before making a jump at the 10-week follow-up. Decreasing informativeness, observed for the majority of the course of treatment, may indicate a lack of generalization from those treatment items on which M showed improvement. Overall, M's discourse production was difficult to analyze quantitatively; both intra- and interrater reliability for CIU counts were low, primarily due to the ambiguity presented by M's fluent but meaningless speech and frequent perseverations. This continued difficulty in analyzing M's discourse further indicates her lack of generalization to this task, as her speech did not become less ambiguous or easier to analyze over time.

The main focus of Schuell's stimulation approach is on intensive auditory stimulation, which often manifests as drill-like tasks similar to those used in this study (Coelho et al., 2008; Schuell et al., 1955). However, Hengst et al. (2010) report that non-drill work is more functionally complex and varied, and can build more "histories of use" for a stimulus item and allow for greater generalization and more flexible communication. The authors argued that clinicians should go beyond being drill instructors and instead focus on being good communication partners for their patients with aphasia. The focus of the current treatment was on bombarding the auditory modality in order to facilitate neuroplastic change; a modified treatment, using more

functional tasks that are more relevant to an individual's day-to-day communication needs, but still following the intensity prescribed by Schuell et al. (1955), may lead to greater generalization of production skills to discourse. Compared to P, who has a nonfluent aphasia and who showed greater generalization to untrained probes, M may also require more treatment to produce the same results, due to the fact that she is not as aware of, and therefore less able to fix, her errors.

M's results on standardized assessments were mixed. Her scores on language-focused metrics were generally improved. Her gains on the WAB-R-AQ is considered clinically significant by multiple metrics, which reflects positively on this treatment protocol (Gilmore et al., 2019; Hula et al., 2010). Her scores on the ACTS also demonstrated clinically significant improvement starting at the five-week follow-up. Her scores on the BNT decreased as time progressed; however, her scores were very low to begin with, and a change of one or two points, while technically statistically significant, may also be attributed to day-to-day variability and is likely not clinically significant.

M's scores on standardized assessments containing more cognitive components showed poorer results than her scores on assessments that focused exclusively on language. These decreased scores on some standardized tests appear negative on paper but may be indicative of an underlying *positive* trend in behavior observed: an increased awareness of errors.

Anosognosia is a major problem in the treatment of Wernicke's aphasia, and some consider it an obstacle to developing a consistently effective treatment protocol for patients with this aphasia type (Wilssens et al., 2015). Throughout the course of treatment, the graduate student clinician noticed M demonstrating increasing frustration when she answered incorrectly, to the point that she would begin to perseverate on the correct answer minutes later—for example, she would fail to identify “pen” from a picture, but four or five pictures later, would label two consecutive

unrelated images “pen”—indicating that she may have still been thinking through the answer she item she hadn’t answered correctly. She would more frequently interrupt standardized testing with expressions of frustration (ex. “I know it,” “I can do things,” “I used to do that,” etc.) and demonstrated more frequent revisions of her answers. This increased frustration and desire to revise her incorrect answers sometimes led to over-thinking, taking too long on a task, or increased agitation and loss of focus, all of which may have impacted her scores on some standardized measures, including the BNT and CLQT. As anosognosia is such a major roadblock in treating Wernicke’s aphasia, the fact that intensive treatment appears to help improve awareness of errors is a very important finding; however, this newfound awareness and accompanying frustration needs to be handled in such a way that prevents it from interfering with the participant’s performance on language and cognitive tasks.

### **The Current Study (M) – Qualitative Results**

Kagan et al. (2008) stated that a patient’s quality of life can improve even if their impairment status doesn’t change, and that the presence of “meaningful” change should be evaluated based on reports from the client and their significant others. In M’s case, both she and her daughter—her primary conversation partner—reported a positive experience with treatment, and M’s daughter additionally reported noticing M’s improved spontaneous speech and increased motivation to practice her language skills. The graduate student clinician who worked with M also noticed improvements in her spontaneous language and a continued positive attitude towards and enthusiasm for treatment. Finally, M’s CETI results indicated improvement of communicative behaviors in 6/16 areas from baseline to posttreatment. (CETI results did indicate significant decline on 16) Describing or discussing something in depth; however, it is thought

that human error contributed to an artificially high rating at baseline, leading to the perception of significant decline when in fact such a decline did not occur.)

These results indicate that, irrespective of her standardized scores, M and her loved ones saw a benefit from treatment, which reflects favorably on the application of this treatment.

### **Comparison of 2017 and 2019 Results**

The participant in the 2017 study, P, was different from M in that he was younger, male, and presented with nonfluent aphasia; he was similar in that his aphasia was both severe and chronic. He received largely the same assessment battery as M and participated in an intensive treatment that was structured in the same way (Hughes, 2017). As shown in Table 5, P demonstrated some similarities to M in terms of his response to treatment, and some differences.

Overall, P's results on probes and standardized measures showed more consistent patterns of clinically significant improvement than M's results. The results of both participants left researchers concerned about maintenance and functional generalization of gains, especially when taking into account information such as P's decline on the WAB-R-AQ at 10 weeks post-treatment; however, both studies supported the idea that a short period of intensive treatment can help restart patterns of recovery that may have stalled in the chronic stages of aphasia, via mechanisms such as the strengthening of neural circuits, increased neuroplasticity, and improvements in the automaticity of language (Hughes, 2017; Kurland et al., 2012). While the current study does not look at physiological neural changes as a result of intensive treatment, it has shown that such a treatment can result in observable, clinically significant behavioral changes.

Both participants showed improvements on trained probes and standardized measures, which support this idea of “kick-starting” recovery in patients with chronic aphasia whose

progress may have been stalled by a phenomenon called “learned nonuse.” This term refers to a habit of not using something which is injured or impaired—in this case communication (Kurland et al., 2012; Taub et al., 1994). However, the participants’ lack of generalization of gains to discourse indicates that more varied and functional treatment may need to accompany Schuell’s stimulation or similar approaches in order to see transfer of skills to more everyday language (Hengst et al., 2010). Use of more functional language treatment may not result in the same degree of rapid improvement as intensive, drill-like training, but researchers have long theorized that the perception of communicative effectiveness by patients and their significant others can still have a very positive effect on their quality of life, and is in itself an outcome of high importance (Chapey et al., 2000; Kagan et al., 2008). It is important to note that we saw a moderate improvement in tested language skills and a positive trend in reported quality of life for two participants, both of whom had been discharged from services for performance plateau. Given that these two had very different presentations of aphasia, it is a positive indicator for the applicability of intensive SSA in the chronic phase of this disorder for those with severe aphasia.

### **Efficacy**

The current study investigated the outcomes of intensive SSA treatment, based on the framework outlined by Coelho et al. (2008), for two patients with chronic aphasia. Both participants showed improvements on standardized language assessments and on trained probes. In addition, P demonstrated improvement on untrained measures and on some cognitive measures—M’s lack of improvement in these same areas was attributed at least partially to increased awareness of errors and resulting frustration over the course of treatment. Neither participant showed generalization to discourse and both may have benefitted from additional functional communication practice to supplement the intensive drill-like nature of SSA. Both

participants anecdotally (and, in M's case, on the CETI) showed improvements in everyday language use and quality of life.

### **Feasibility**

A massed practice (30 hours over 10 days) administration of SSA was tolerated well by both participants. Neither participant was late, missed a day, or needed to leave early. Both participants maintained attention and motivation throughout every session, though they did report some fatigue. Family members remarked that participants were eager to attend. These were two people with supportive family members and positive attitudes who may have had a higher premorbid toleration for frustration, so we cannot draw any sweeping generalizations; however these results are positive for the feasibility of SSA for highly motivated individuals with chronic aphasia characterized by severe auditory comprehension deficits (Hughes, 2017).

### **Limitations**

Due to the intensive nature of the treatment program, participant fatigue likely contributed to performance variability for both participants. Other individual factors may have influenced participant performance day to day—for example, M suffers from intermittent sinus pain as a result of medical procedures related to her CVA, and would on some days indicate that this pain was bothering her more than usual.

It was noted that M appeared to struggle with some later assessments due to increased awareness of her errors, but it is also likely that both participants underperformed on some cognitive assessment tasks due to the language processing demands involved in both understanding directions and producing a response.

Finally, given the heterogenous nature of aphasia, it is impossible to claim that these participants are completely representative of chronic fluent and nonfluent aphasia—further replication needs to be carried out before results can be generalized to a population.

## **Conclusion**

The results of the current and the 2017 study show promise for the application of intensive Schuell's stimulation approach for individuals with chronic aphasia. The participants in both the 2017 and 2019 studies saw improvements in quantitative and qualitative measures of language use following participation in treatment. In the 2019 study, it was also found that intensive Schuell's stimulation appeared to increase the participant's awareness of her errors, as evidenced by improvements in language use concurrent with a decline in cognitive testing scores, and by the participant's behavior as noted by the graduate student clinician.

In future research, it will be pertinent to examine maintenance of gains following intensive treatment over a longer course than 10 weeks, to observe how participants' language functions continue to improve or decline. It is possible that improved quality of life and increased access to language outside of the treatment setting may lead to continued improvements over time; however, it is also possible that the withdrawal of intensive treatment may lead to a regression in language skills as the individual returns to their normal, generally lower, levels of language use. Language abilities of PWAs decline or improve over time as a result of degree of use, but it remains to be seen whether the improved access to language posttreatment outweighs the detrimental effects of the removal of treatment. In the meantime, the improvement in language scores, participant confidence, and quality of life cannot be ignored, and all point to intensive Schuell's stimulation approach as a potential treatment option for patients in the chronic stages of aphasia.

## Appendix A

### *Communicative Effectiveness Index (CETI) items.*

Please rate \_\_\_\_\_'s ability at...

1. Getting somebody's attention.
2. Getting involved in group conversations that are about him/her.
3. Giving yes and no answers appropriately.
4. Communicating his/her emotions.
5. Indicating that he/she understands what is being said to him/her.
6. Having coffee-time visits and conversations with friends and neighbors (around the bedside or at home).
7. Having a one-to-one conversation with you.
8. Saying the name of someone whose face is in front of him/her.
9. Communicating physical problems such as aches and pains.
10. Having a spontaneous conversation (i.e. starting the conversation and/or changing the subject).
11. Responding to or communicating anything (including yes or no) without words.
12. Starting a conversation with people who are not close family.
13. Understanding writing.
14. Being part of a conversation when it is fast and there are a number of people involved.
15. Participating in conversations with strangers.
16. Describing or discussing something in depth.

(Taken from Lomas et al., 1989)



Appendix B

Experimental stimuli lists. A \* indicates that the card was lost between the 2017 and 2019 studies; these words were replaced with the words “straw,” “needle,” and “mouse” in the 2019 study. Directions requiring verbal behaviors were not included in the results.

Task	Noun Comprehension (P only; discontinued for M)		Noun Production (P and M)			One-Step Directions (trained only for M; all untrained for P)		
	Trained	Untrained	Trained	Untrained	Trained	Untrained		
<b>Stimuli</b>	referee	pot	cabbage	frog	mirror	zipper	Give me	Turn over
	scarf	blanket	jam	broom	ear	owl	Pick it up	Point to
	bucket	jacket	umbrella	clown	fly	worm	Put it upside down	Point to with the pen
	garbage	beer	cheese	vase	corn	stool	Put it on top of	Hold in your right hand
	flashlight	chicken	sandwich	hook	snake	turtle	Put it to the left	Hold in your left hand
	glove	smoke	airplane	pear	ring	turkey	Put it to the right	Put your hands over your eyes
	salad	meat	priest	comb	cross	balloon	Put it under	Give a thumbs up
	hose*	salt	fountain	trumpet	truck	rabbit	Put your hands on your shoulders	Pretend to comb your hair/brush your teeth <sup>1</sup>
	chocolate	dollar	screw	pig	box	tub	Point to the door	<del>Count to ten</del>
	thumb	phone	bowl	pants	watch	razor	Pretend to wash your hands	<del>Say your name</del>
	leaf	hat	tea	button	ship	fan	Close your eyes	
	rug	newspaper	bird	drum	bridge	cow	Cross your fingers	
	stove	coffee	drill	egg	heart	belt	Wiggle your fingers	
	bell	mouth	bread	toilet	shark	bus	Clap your hands	
	amp*	sun	dirt	rope	sock	fish	Point to your nose	
	toast	fire	suit	basket	tree	brush	Put your hand over your mouth	
	clock	feet	wood	pen	tooth	knife	<del>Say hello</del>	
	plate	hand	glass	ladder	shoe	train	<del>Name a number</del>	
	beard	house*	table	tire	ant	key	<del>Name a shape</del>	
	butter	wine	door	sink	horse	window	<del>Name a color</del>	

<sup>1</sup> “Pretend to comb your hair” was mistakenly trained during the first two days of treatment; thereafter “Pretend to brush your teeth” was used in probing.

Appendix B (cont.)

*Stimuli shown with Kučera-Francis written frequency (1967), sorted more to less frequent.  
 “N/A” indicates that the data base did not return a frequency number for the word.*

Noun Comprehension				Noun Production			
Trained		Untrained		Trained		Untrained	
Word	KKFRQ	Word	KKFRQ	Word	KKFRQ	Word	KKFRQ
hand	431	table	198	heart	173	window	119
feet	283	glass	99	horse	117	key	88
fire	187	wood	55	teeth	103	train	82
sun	112	suit	48	bridge	98	knife	76
mouth	103	dirt	43	ship	83	brush	44
coffee	78	bread	41	watch	81	fish	35
wine	72	drill	33	box	70	bus	34
newspaper	65	bird	31	tree	59	cow	29
hat	56	tea	28	truck	57	belt	29
phone	54	bowl	23	cross	55	fan	18
salt	46	screw	21	ring	47	razor	15
dollar	46	fountain	18	snake	44	tub	13
meat	45	priest	16	corn	34	rabbit	11
smoke	41	airplane	11	fly	33	balloon	10
chicken	37	sandwich	10	ear	29	turkey	9
beer	34	cheese	9	mirror	27	stool	8
jacket	33	umbrella	8	sink	23	turtle	8
blanket	30	jam	6	tire	22	worm	4
pot	28	cabbage	4	ladder	19	owl	2
butter	27	tweezers	N/A	pen	18	zipper	1
beard	26			basket	17		
plate	22			rope	15		
clock	20			shoe	14		
toast	19			toilet	13		
bell	18			egg	12		
straw	15			drum	11		
stove	15			button	10		
needle	15			pants	9		
rug	13			pig	8		
leaf	12			trumpet	7		
thumb	10			pear	6		
mouse	10			comb	6		
glove	9			ant	6		
salad	9			hook	5		
chocolate	9			vase	4		
flashlight	8			sock	4		
bucket	7			clown	3		
garbage	7			broom	2		
scarf	4			frog	1		
referee	1			shark	N/A		

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