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# The Effect of an Intensive Oral Reading Program on Discourse in Chronic Mild Aphasia

Marilyn Elizabeth Richard

*University of Connecticut - Storrs*, [marilyn.richard@uconn.edu](mailto:marilyn.richard@uconn.edu)

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# The Effect of an Intensive Oral Reading Program on Discourse in Chronic Mild Aphasia

Marilyn E. Richard

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# APPROVAL PAGE

Masters of Arts Thesis

## The Effect of an Intensive Oral Reading Program on Discourse in Chronic Mild Aphasia

Presented by

Marilyn E. Richard, B.A.

Major  
Advisor

---

Jennifer Mozeiko, Ph.D.

Associate  
Advisor

---

Carl A. Coelho, Ph. D.

Associate  
Advisor

---

Emily B. Myers, Ph. D.

University of Connecticut

2015

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## **Abstract**

*Background:* There is limited research specific to deficits and interventions for people with mild aphasia (PWMA), although they have the greatest potential to return to work. Discourse and reading deficits for this population are well documented and negatively impact quality of life. Two treatment programs have used oral reading to target discourse with mixed success. Neither was designed specifically for PWMA.

*Aims:* The primary aim of the current study was to examine the effect of an intensive oral reading program on discourse in two participants with chronic mild aphasia. Outcome was also assessed on several other measures including oral reading, reading comprehension and attention.

*Methods & Procedures:* Two adults with chronic mild fluent aphasia, one male and one female, participated in an intensive oral reading program. The study design included pre-treatment testing followed by 3 hours of treatment per day for 2 weeks. Post-treatment testing occurred 1-2 weeks and again at 7-8 weeks after the completion of therapy. Outcome measures included productivity, informativeness, and efficiency of discourse, rate, accuracy, fluency, and comprehension of oral reading, and various assessments.

*Results:* Participant 1 improved on several language and cognitive assessments (WAB-R, TEA, GORT-5, BNT), discourse productivity, and reported that the treatment made an impact on her life. Participant 2 exhibited improvements in attention and oral reading, evidenced by increases on the TEA and GORT-5.

*Conclusions:* This oral reading program shows promise as a treatment method to address discourse and reading deficits in PWMA.

## **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

Aphasia is an acquired, selective impairment of the cognitive system specialized for language, that often leaves other cognitive systems relatively intact (Davis, 2013). The National Aphasia Association (2010) estimates a prevalence of one million people with aphasia in the United States that, as discussed by Code and Petheram (2011), will likely continue to increase as survival rates from stroke increases. These numbers solidify the need to continue to explore intervention methods for chronic aphasia, as this population will continue to grow.

Although there appears to be a wide variety of research in people with aphasia (PWA), there is a glaring gap in the literature. There is limited research specific to deficits in people with chronic mild aphasia and interventions to address those difficulties, even though individuals with mild aphasia are those with the best potential for returning to work. Additionally, very little research is available on people with mild aphasia (PWMA) regarding their return to work rates and quality of life post-stroke, even though they report significant disruptions in communication (Cruice, Worrall, & Flickson, 2006; Elman & Bernstein-Ellis, 1995). Researchers who do include PWMA in investigations often do not differentiate treatment according to severity. This makes it difficult to determine whether this population might differ in its treatment response. As mentioned by de Riesthal and Wertz (2004), individuals with more severe aphasia may show larger gains on pre to post-treatment measures, arguably because they have more room for improvement, and those with mild aphasia quickly reach a “ceiling” and may be unable to show much improvement on measures designed to be sensitive to more moderate aphasia symptoms. Additionally, the glaring impact severe aphasia can

have on functional communication may also explain why this subset of the population is studied more frequently. Compared to those with severe aphasia, PWMA appear highly functional, and are thus overlooked. Research tends not to study individuals who qualify close to “normal” on assessments, when the focus could be on a population who appears to be at a much greater disadvantage.

## **Background**

An individual is typically considered to have reached the chronic stage when their impairments become residual, lasting longer than one-year post onset. Less commonly, researchers use the term chronic to describe PWA 6 months after stroke. Prior to entering the chronic phase, many PWA experience an early stage of language recovery between 1 to 3 months, which coincides with the period of spontaneous recovery (Kertesz & McCabe, 1977). In their longitudinal study of individuals with ischemic stroke, Skilbeck and colleagues (1983) found that participants made slight improvements up to 6 months post-onset. Similarly, in their study of 52 stroke patients with aphasia, Lendrem and Lincoln (1985) found statistically significant progress between 1 to 5.5 months.

When considering treatment efficacy, it is important to keep in mind the timeframe between the intervention period and time of onset. If intervention is performed after the period of spontaneous recovery, any changes may be more confidently attributed to treatment.

Another fairly standard procedure in aphasia research is the means of determining factors like severity of impairment and treatment outcomes. For research

purposes, severity of aphasia tends to be defined by an individual's score on a standardized assessment (Bakheit et al., 2007; Pederson, Vinter, & Olsen, 2004; Roberts, Code, & McNeil, 2003). Scores from standardized assessments are also used to determine outcome after treatment studies (Meinzer, Djundja, Barthel, Elbert, Rockstroh, 2005; Pulvermüller et al., 2001; Richter, Miltner, & Straube, 2008). However, solely using standardized assessments to determine outcome measures, particularly in studies involving PWMA, has significant limitations. As mentioned previously, PWMA score higher on standardized assessments (indicating a lower severity of impairment) and therefore do not have far to go until they reach the cutoff score for what is considered "normal," but this is often misleading. PWMA reach the "normal" level which makes it appear as though they are no longer impaired, even when anomia, grammatical errors, and discourse inefficiency persists. Because the use of standardized assessments as outcome measures has its limitations, it is important to use alternate methods to track changes in language abilities, such as examining discourse. For instance, Boyle (2011) recommends using macrolinguistic analysis methods that assess cohesion and coherence, quantify the amount of information and efficiency with which it's produced, or assess whether main concepts are conveyed.

The errors inherent within this population are extremely variable and the language profiles of PWA differ depending on many variables, including type and severity of aphasia, pre-morbid factors, and numerous components specific to the individual. Although deficits are quite individualized, a handful of symptoms are typically seen in the majority of PWMA, though to varying degrees. These include anomia, agrammatism, and comprehension deficits.

Problems with word-finding, often referred to as anomia, are common among virtually all people with aphasia (Goodglass & Wingfield, 1997). Word-finding difficulties may present in multiple ways. For some, it may be slowness in producing a target word. Others may demonstrate circumlocution, or talking around the target word, such as “I wear it on my wrist” to describe a watch (Davis, 2013). In terms of language production, PWMA may present with agrammatism, in which grammatical morphemes are omitted from sentences (Goodglass, 1993). In addition to deficits in language expression, research has concluded that PWA have difficulty with comprehension at the sentence level (Heeschen, 1980; Pierce & Wagner, 1985).

### **Discourse in aphasia**

People with mild aphasia may have symptoms including anomia, agrammatism, and even mild comprehension deficits. Perhaps most impactful to social relationships and quality of life, however, are deficits in discourse.

Discourse can be defined as a unit of language that conveys a message. It is frequently considered to be a series of connected sentences, but may also come in the form of a single word, phrase, sentence, or any combination of the above (Ulatowska, Allard, & Chapman, 1990). Numerous studies have concluded that discourse abilities are impaired in PWA, across all severity levels. Chapman and colleagues (1998) investigated discourse performance across three groups of participants: mild-moderate aphasia, mild-moderate Alzheimer’s disease, and typical controls. The results of their study indicate that discourse abilities across a range of tasks were impaired in PWA and

impairments were characterized by reduced content, incoherent responses, verbosity, and word finding deficits.

Yorkston and Beukelman (1980) also examined discourse performance in people with mild to moderate aphasia compared to typical adults and elderly speakers. Picture descriptions were analyzed for the amount of information conveyed and two measures of efficiency: speaking rate and rate that information was conveyed. They found that the group with mild aphasia did not differ in the amount of information conveyed compared to typical adults, but they were much less efficient. Additionally, the speaking rates of all groups with aphasia were slower than typical controls.

Likewise, Honda and colleagues (1999) conducted a study investigating the discourse abilities of chronic PWMA compared to controls using retells of a TV program viewed by participants. The PWMA scored greater than 80% on the Standard Language Test of Aphasia (Hasegawa, Takeda, Tsukuda, Takeuchi, & Wada, 1975). Discourse analyses focused on two main aspects: organizational structure and amount of information. The analysis of organizational structure included 3 components: reference of the topic for the procedure, proportion of structural components, and organizational pattern of the structural components. The amount of information conveyed was determined using a total word count and correct content word count. The total word count included all the words produced by each participant and the correct content words referred to the 45 informative and relevant words that the authors pre-determined, according to the TV program. Overall, the results of this study indicate that discourse abilities, specifically structural organization and amount of information, were limited in chronic PWMA compared to controls. There was a significant difference in the number

of correct content words between the subjects with aphasia and the control group. Specific areas of difficulty within structural organization for the group with aphasia include reference to topic, and the organizational pattern of the structural components.

In addition to the difficulties mentioned above, PWA may also show reduced informativeness and efficiency of their connected speech. In their study comparing 20 PWA of varying severity levels to 20 non-brain-injured adults, Nicholas and Brookshire (1993) developed a standardized, rule-based scoring system to evaluate discourse abilities, called the Correct Information Unit (CIU) analysis. Connected speech samples were elicited using a variety of stimuli materials, including single pictures, picture sequences, and requests for personal information and procedural information. The samples were then transcribed, timed, and scored according to the CIU rules laid out by the authors. This list of rules was used by the authors of the current study in their discourses analyses. Words had to be intelligible in context but did not have to be relevant, accurate, or informative to the stimulus to be included in the word count. To be included in the CIU count, words were required to be relevant, informative, and accurate relative to the stimulus. Time, word counts, and CIU counts were then used to calculate words per minute, percent of words that were correct CIUs, and CIUs per minute. Based on the results of this study, the authors concluded that the non-brain-injured group produced more CIUs, more words, a higher percentage of CIUs, and more CIUs per minute than the group with aphasia. These findings coincide with the results of the previous studies that concluded PWA demonstrate deficits in linguistic formulation and structural organization and reduced informativeness and efficiency of their discourse.

## Reading in aphasia

Reading difficulties are another common, and limiting, symptom in PWA. In their study of 35 participants with chronic aphasia, Webb and Love (1983) examined oral reading, comprehension, and recognition of written words and sentences. A series of 12 reading tests were utilized to gain information on reading abilities. Their findings indicate that reading difficulties remained a considerable part of the language deficit in the majority of subjects. Results on the comprehension tests demonstrated the lowest scores, then oral reading, and lastly recognition tests. Similarly, others have concluded that impairments in reading are often a primary aspect of the overall language disorder in PWA (Hécaen & Kremin, 1976; Kertesz, 1979).

Reading is an integral part of everyday life. Many day-to-day tasks require intact reading skills, such as reading road signs, following a recipe, and staying up to date with the daily newspaper. Even a mild reading deficit can make many of these daily tasks difficult and frustrating, impacting an individual's quality of life. Coelho (2005) demonstrated that one highly functional individual with mild aphasia rated her quality of life as poor specifically due to her decreased reading ability.

*Treatment of reading in aphasia.* Numerous interventions have been investigated to address the reading deficits inherent in aphasia. The brief exposure method involves the presentation of written words for a brief duration so that letter-by-letter reading cannot be utilized, though results have been variable (Maher, Clayton, Barrett, Schober-Peterson, & Rothi, 1998; Rothi & Moss, 1992). Other reading intervention procedures include the use of cross-modality cueing to enhance letter identification (Maher et al., 1998) and written word-to-picture matching to strengthen semantics (Hillis &

Caramazza, 1991). Overall, these strategies targeted improvement of reading abilities, which was not the focus of the current study. Because the main outcome of the current study was to improve discourse, an oral-verbal process, the focus was on oral reading treatment methods as opposed to the other reading treatments available.

Various studies have indicated that treatment for oral reading may impact discourse. As discussed by Cherney (2010b), this may be explained by multiple reasons. First, the Oral Reading for Language in Aphasia (ORLA) treatment method incorporates multimodal stimulation (visual written in addition to verbalizing aloud) and repeated practice in auditory comprehension and oral expression. Alternatively, the influence on discourse production may be due to the interactive processing that occurs during oral reading, which enhances degraded lexical information. Rogalski and colleagues (2013) offer other suggestions as to why oral reading impacts discourse. In their study investigating the effect of Attentive Reading and Constrained Summarization (ARCS; Rogalski et al., 2013), the authors concluded that the “constraint” aspect of the program promotes effortful language use, which is thought to reengage underutilized areas of the brain.

Although deficits in reading can negatively impact quality of life, it is the psychosocial impact of stroke that is arguably one of the most devastating consequences. Many aspects of an individual’s life are changed, as demonstrated by Teasedale and Engberg (2005), who investigated the psychosocial status of 450 stroke patients. They concluded that the following psychosocial factors were affected by stroke: return to employment, social relations, and leisure activities. Even participants who were employed prior to suffering from a mild stroke were unable to return to work

as normal. Additionally, the presence of aphasia at discharge had a negative effect on various outcomes involving a social component (e.g. employment, social relations).

As one can imagine, deficits in discourse and oral reading can result in limitations in the psychosocial aspects of an individual's life. Treatment that results in improving the psychosocial impacts of aphasia is, arguably, more important than addressing language deficits inherent to the disorder.

### **Cognitive deficits in aphasia**

Although impairments in various language modalities are the primary deficits in PWA, cognitive deficits are also present in aspects of memory and attention (Christensen & Wright, 2010; Erickson, Goldinger, & LaPointe, 1996; Murray, 2012). Additionally, Murray (2012) found that all participants with mild aphasia demonstrated deficits on at least one cognitive measure, which is consistent with previous research (Hunting-Pompon, Kendall, & Moore, 2011). She discusses the need to include cognitive testing within assessment protocols for PWA and supports the recommendation that every client with aphasia receive a cognitive evaluation, regardless of their level of severity (Murray, 2012).

This is particularly relevant to the current study, as both participants were mild in severity and, thus, may have undiagnosed weaknesses in cognitive domains that should be monitored for change/response to intervention. Furthermore, several aspects of the treatment in the current study suggest that changes in attention, would be likely. First, the rigorous and intensive schedule of the protocol requires participants to maintain focus and attention throughout the duration of intervention in order to answer

comprehension questions. Resource allocation theory (McNeil, Odell, & Tseng, 1991) suggests that each individual has a finite attentional capacity. Attention is compromised when demand for attention exceeds either the pool of resources available or the ability to draw on that pool. Attention practice would be thought to improve attention in the same way oral-verbal language has been improved as a result of intensive interventions focusing on oral-verbal language (e.g., Constraint Induced Language Therapy studies; Pulvermüller et al., 2001).

Treatment targeted on improving attentional skills has resulted in improvements in reading comprehension (Coelho, 2005; Sinotte & Coelho, 2007) and overall aphasia severity (Helm-Estabrooks, 1998). The opposite is presumed to be true as well, that improvements from treatment of language and reading deficits would result in corresponding improvements in attention.

In sum, addressing cognition and including cognitive assessments is important when investigating language in individuals with aphasia, as previous research has demonstrated most PWA have a deficit in one cognitive area (Murray, 2012).

### **Intervention methods for aphasia**

There are few treatment studies that have focused specifically on people with mild aphasia. Treatment methods include training discourse to improve word finding (Boyle, 2011), computer drill training (Ramsberger & Marie, 2007), and Constraint Induced Language Therapy (CILT; Pulvermüller et al., 2001), among few others.

Boyle (2011) reviewed seven studies investigating discourse treatment, including methods such as phonological and orthographic cueing and repeated conversational

engagement, to improve word retrieval in PWA. Results indicate all investigations resulted in improved word retrieval abilities, and focusing on treatment of word retrieval resulted in changes in discourse informativeness. Ramsberger and Marie (2007) also examined a treatment for word finding deficits using a self-administered, clinician-guided, computer-based, cued naming therapy. The results of this study indicate improved naming of trained words in 3 out of 4 participants, with evidence of maintenance. Although the majority of the treatment for PWMA is word finding, it does have implications for discourse as improvements in word finding have been shown to improve informativeness (Boyle, 2011).

Alternatively, treating discourse directly is much less common. Rodriguez and colleagues (2013) included narrative discourse training for two participants in their Intensive Comprehensive Aphasia Program (ICAP). These two participants made improvements in efficiency and informativeness and gains were maintained for one of them.

An additional method to treat discourse deficits in PWA involves focusing on oral reading and results to date have been generally successful. However, studies seldom targeted PWMA in particular, although they may be included in their participant pool (Cherney, 2010a; Cherney 2010b; Rogalski et al., 2013). Oral Reading for Language in Aphasia (ORLA; Cherney, 2010b) is a treatment method that requires participants to systematically and repeatedly read sentences and paragraphs aloud, in unison with the clinician first and then independently. Within ORLA there are four levels of difficulty based on length and reading level, ranging from simple 3-5 word sentences at a first grade reading level, to 50-100 words in a simple paragraph at a sixth grade reading

level (Cherney, 2010a). Although it was first developed to enhance reading comprehension (Cherney, 2004; Cherney, Merbitz, & Grip, 1986) results showed that improvements were also made in auditory comprehension, written expression, and oral expression in both fluent and nonfluent aphasia as well (Cherney, 1995; Cherney, 2004; Cherney, Babbitt, & Oldani, 2004; Cherney, Babbitt, Oldani, & Semik, 2005; Cherney et al., 1986). When investigating the differential effects of ORLA on 10 participants with mild-moderate aphasia, a medium effect size was calculated for efficiency of narrative discourse and picture description as measured by CIUs/min (Cherney, 2010b). There were no significant improvements in reading performance as measured by the Reading Comprehension Battery of Aphasia-2 (LaPointe & Horner, 1998) and effect sizes for reading comprehension were found only for the group with severe aphasia, according to the reading subtest of the Western Aphasia Battery Revised (WAB-R; Kertesz, 2006). Effect of treatment has not been tested for participants with a score over 85 on the WAB-R AQ but the benefits of ORLA have been well documented in the literature across a range of severity levels (Cherney, 2010a; Cherney, 2010b; Cherney et al., 2005) making it a promising program to consider for treating discourse deficits in PWMA.

One other oral reading program implemented to improve discourse deficits in PWA is Attentive Reading and Constrained Summarization (ARCS), a cognitive-linguistic intervention that concentrates on reading aloud and orally summarizing the text while refraining from use of vague/non-specific language. The constraints imposed during ARCS aim to promote attention to topic maintenance and the intentional use of linguistically specific words (Rogalski & Edmonds, 2008). In their recent study, Rogalski

and colleagues (2013) evaluated the effect of ARCS on lexical retrieval abilities in two participants with chronic moderate to severe Wernicke's aphasia. The stimuli used for treatment was abridged news articles and the protocol, with several additions made, followed that of the original ARCS protocol (Rogalski & Edmonds, 2008). This involved three steps: 1) read 2-3 sentences aloud with the intent to summarize, 2) re-read silently for comprehension, and 3) summarize the 2-3 sentences aloud while maintaining the topic and using meaningful language (e.g. refrain from vague language, such as "thing" and "stuff"). These three steps were repeated until the entire article was completed and the additions made to this protocol include previewing, re-reading for feedback, and summarizing the whole article. The results of this study indicated that the participant with moderate Wernicke's aphasia improved on primary outcome measures, including raw scores from the Boston Naming Test (Kaplan, Goodglass, & Weintraub, 1983) and informativeness (%CIUs; Nicholas and Brookshire, 1993) of picture descriptions and article retells. The results of the Comprehension and Communication Survey (Rogalski et al., 2013) indicated that intervention made a functional impact on this participant's life. Although this study included participants with moderate to severe Wernicke's aphasia, application to PWMA would be reasonable. It uses more challenging content than ORLA and requires attention to vague language such as "thing" or "stuff"—filler words that might be substituted during episodes of word finding.

The restraint of vague language in ARCS was based on the principles of CILT (Pulvermüller et al., 2001) but Rogalski et al. (2013) did not restrain other modalities. The use of CILT, which requires participants to refrain from the use of compensatory, non-verbal communication strategies and to produce verbal responses, has guided the

most recent aphasia research. In the original study, Pulvermüller and colleagues (2001) compared the effects of CILT to conventional aphasia therapy. The results of this study showed that participants in the CILT group made significant improvements in language performance and increased verbal communication in daily life. Subsequent studies involving CILT have found similar improvements in communication (Kurland, Pulvermüller, Silva, Burke, & Andrianopoulos, 2012; Meinzer et al., 2005). Other CILT studies that have included PWMA resulted in mixed outcomes (Maher et al., 2006; Meinzer et al., 2008; Mozeiko, Coelho, & Myers, 2015). CILT is now often referred to as Intensive Language-Action Therapy (ILAT).

In addition to the effects of oral reading on discourse, oral reading has also been examined in relation to attention. Specifically, treatment of attention has been used to improve reading in PWMA (Coelho, 2005; Sinotte & Coelho, 2007). Attention deficits commonly co-occur with aphasia and have been found to play a role in both receptive and expressive language performance (Murray, 2012). Thus, there is a need to train attention either directly or indirectly in people with aphasia (Murray, 2012).

## **Dosage**

Numerous researchers have concluded that the typical outpatient treatment dosage for aphasia, approximately 1-3 hours per week for several months, is not the most effective intervention dosage. In the study by Pulvermüller and colleagues (2001) detailed above, participants were assigned to either a short, intensive CILT therapy for 3 hours per day for 10 consecutive days, or to a conventional treatment for fewer hours per week over the course of 4 weeks. The results indicate that participants in the short,

intensive CILT treatment made significantly greater improvements on language/communication measures compared to the conventional treatment group. Likewise, Mozeiko, Coelho, and Myers (2011) compared constraint-induced therapy administered at two intensity dosages to adults with chronic aphasia. Both groups of participants received a total of 30 hours of treatment, one delivered over a 10-week period and the other over a 2-week period. The authors concluded that the intensive 2-week treatment yielded better results on discourse measures and, importantly, maintenance of improvements was better for those who received the intensive CILT.

In an effort to maximize the treatment response for two participants with mild and chronic aphasia, important findings from the above research were incorporated into the design of this study, including the intensive schedule, constraint of vague and non-specific language, the game-like format used in ILAT, and the use of oral reading to improve discourse abilities.

### **The current study**

The overall objective of this study was to assess whether an intensive, oral reading treatment program would improve the discourse abilities of individuals with chronic mild aphasia with results exceeding those seen following ORLA. By using longer articles and requiring the participant to retell the text, it was expected to be more challenging and at a level more appropriate for PWMA. Administering a high intensity program with an interactive group format was predicted to increase efficacy. In addition, this study investigated whether this program would impact reading comprehension, an effect not realized following ORLA for those with mild-moderate aphasia and not tested

following ARCS. Examining the rate, accuracy, and fluency of the oral reading skills of PWA and its potential impact on discourse production and reading comprehension was a secondary objective of this study. This study will address the following research questions related to behavioral changes over time, as measured by treatment probes, generalization probes, qualitative assessments, and standardized tests.

### **Research questions**

The current study served to address three main questions: For participants with chronic mild aphasia, will intensive oral reading 1) Improve discourse, measured by efficiency, productivity, and/or informativeness? 2) Improve accuracy, rate, and/or fluency of oral reading? 3) Improve reading comprehension, as measured by the Gray Oral Reading Tests- 5<sup>th</sup> Edition (GORT-5; Wiederholt & Bryant, 2012) and/or the reading subtest of the Western Aphasia Battery Revised (WAB-R; Kertesz, 2006)?

Based on the theoretical principles and results of prior research, discussed previously, as well as modifications to protocols already established, it was hypothesized that this program would result in improvements in the areas of discourse, oral reading abilities, and reading comprehension. By increasing the reading demands of the treatment stimuli and utilizing an intensive treatment dosage, we expected to see greater changes in discourse than what was previously found (Cherney, 2010b). Because the format of the current study required participants to remain active listeners and answer comprehension questions during treatment, we anticipated gains in reading comprehension, though this was not observed for the mild population in previous treatments using oral reading (Cherney, 2010b). Finally, we predicted improvement in

oral reading abilities because the entire treatment was focused on reading aloud. Thus, we expected to see changes in rate, accuracy and fluency of oral reading.

## Method

### Participants

Two adults were recruited from the University of Connecticut community to serve as participants in this study. Participants provided informed consent prior to the beginning of the study. One female and one male, ranging in age from 48 to 54 years, served as participants in this study. Both participants achieved a high school education, or greater, and were employed prior to their stroke. They were right-handed, native monolingual speakers of American English, with corrected vision. Participants were greater than one-year post a unilateral, single stroke, had no concomitant illnesses, and no history of speech, language, or literacy disorders prior to their respective strokes. Using the procedures described below, diagnoses of aphasia were confirmed for the purposes of this study. Additionally, hearing acuity was determined adequate for the purposes of this study by passing a hearing screening at 500, 1,000, 2,000 and 4,000 Hz at 35 dB. Throughout the duration of this experiment, participants agreed to refrain from any speech and language intervention they were receiving outside of this treatment study, until post-treatment assessments were completed. Between post-treatment and follow-up assessment, subjects resumed participation in a local, social communication group for people with aphasia for 1.5 hours per week. In the current study, participants received joint intervention after undergoing an identical assessment battery, all of which is described in detail below. Both received compensation for their time and travel to participate in this experiment. Demographic data for each participant appears in Table 1.

At baseline testing, both participants scored within normal limits on the Cognitive Linguistic Quick Test (CLQT; Helm-Estabrooks, 2001), which was used to assess individuals' relative memory, attention, executive functions, visual spatial skills, and language abilities. Diagnoses, according to the Western Aphasia Battery Revised (WAB-R; Kertesz, 2006), included mild fluent conduction and mild fluent anomic. Characteristics of their respective aphasias differed greatly, though both demonstrated fairly intact auditory comprehension. Participant 1 (P1) had a supportive partner and was highly motivated. Prior to treatment P1 reported ability to read headlines and parts of short articles but she desired to read longer articles and books as she did before her stroke. She stated wanting to improve her reading ability in order to discuss the content with friends. She was extremely social and her desire to communicate ideas with friends was a motivating factor for her. P1's oral reading was characterized by frequent errors that made it difficult for the listener to comprehend.

Participant 2 (P2) was highly motivated to improve his speech and was interested in resuming work in some capacity. He had participated in a prior, 60-hour intensive CILT research study conducted at the University of Connecticut. Similar to P1, he expressed interest in improving reading ability. Prior to treatment, P2's oral reading was slow and effortful. He frequently backtracked while reading, repeating text that had been decoded correctly.

**Table 1.** Participant Characteristics

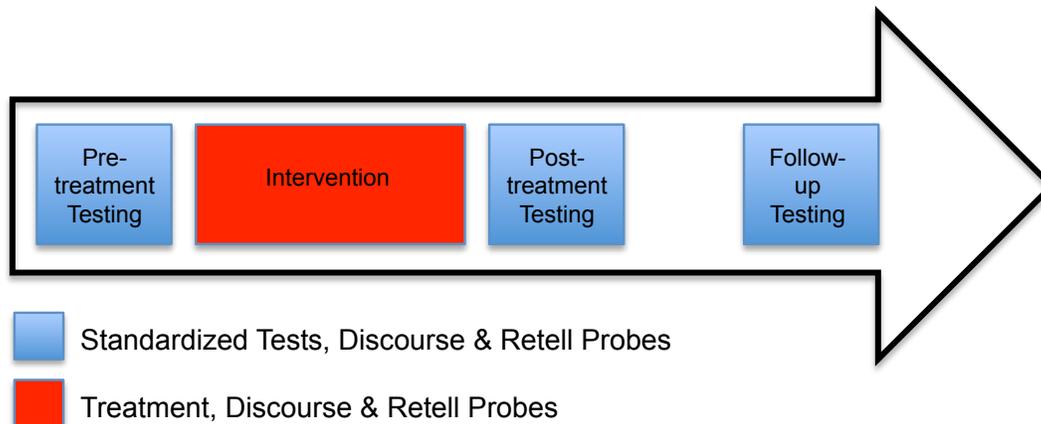
	P1	P2
Age	54	48
MPO	15	63
Sex	Female	Male
Handedness	Right	Right
Occupation	Smoking cessation coach	Finance
Premorbid Education*	12+	16+
CLQT**	60.0%	63.3%
WAB-R		
Diagnosis	Mild Fluent Conduction	Mild Fluent Anomic
Pre-treatment AQ	75.3	91
Aphasia Characteristics	Frequent paraphasias, inconsistent awareness of errors	Word-finding difficulties, requent self-revisions, extremely aware of errors

**Note.** P1= participant 1, P2= participant 2, MPO= months post onset, \*number of years, \*\*Assessed during baseline testing. WAB-R= Western Aphasia Battery Revised (AQ= Aphasia Quotient), CLQT= Cognitive Linguistic Quick Test.

## Assessment procedure

The design of this intervention included 10 three-hour sessions of therapy. As demonstrated by Figure 1, several measures of assessment were administered to participants 1-6 weeks pre-treatment, immediately post-treatment (1-2 weeks), and at a follow-up visit (7-8 weeks post-treatment). Reliability of standardized assessments, when available, is discussed.

**Figure 1.** Timeline of behavioral assessments and treatment.



*Measures of language performance.* The Western Aphasia Battery Revised, or WAB-R (Kertesz, 2006), is a validated quantitative assessment used to measure both the severity of language deficits as well as changes in language function over time (Bakheit, 2007). This is one of the most frequently used assessments to determine severity of aphasia in the literature (Roberts et al., 2003).

The Boston Naming Test (BNT) is a 60-item standardized, confrontational naming task used to assess word finding ability (Kaplan et al., 1983). Participants are presented with line-drawn pictures, ordered from least to most difficult, and have 20 seconds to name each item correctly. The BNT is one of the most frequently used neuropsychological assessment instruments (Rabin, Barr, & Burton, 2005).

The Discourse Comprehension Test (DCT) is a standardized assessment developed to assess narrative comprehension, specifically, understanding of explicit or implicit main ideas and details (Brookshire, & Nicholas, 1993). Brookshire and Nicholas (1993) report strong test-retest reliability for the DCT ( $r = .87$ ), which is a measure of how consistent the results of an assessment are over time. They also report a standard

error of measure (SEM) of two, suggesting high test-retest stability for overall scores on the DCT. The SEM permits one to establish consistency, or reliability, with which a test measures performance on repeated occasions. Multiple versions of this assessment were used in this study.

In addition to pre- and post- treatment testing, the following two measures probed discourse performance throughout the duration of the treatment period. Norman Rockwell prints were presented to participants to elicit discourse production. The prints were presented with the phrase, "Tell me what's going on in the picture," and participant responses were video recorded for later analysis. No time limit for responses was established and participants did not receive any feedback regarding the content or quality of their narrative descriptions. As discussed by Chapman and colleagues (1995), Rockwell prints are chosen as stimuli because they are contextually rich and illustrate well-known life situations. Additionally, these prints have been used as discourse stimuli in numerous research studies (Bayles, Boone, Tomoeda, Slauson, & Kaszniak, 1989; Ulatowska & Chapman, 1991). Analysis of the narrative descriptions is described in detail below.

In addition, Cable News Network (CNN) articles ([www.cnn.com](http://www.cnn.com)) were chosen at random to elicit discourse production in the form of story retells. Immediately after participants orally read the news articles, they were prompted for retells with phrases such as "Tell me what you read about." Articles used for treatment and testing had a mean word count of 357.38 (SD= 50.84, range= 218 – 419) and covered a wide variety of topics, including opinion pieces, travel, living, world news, and health and wellness. To control for word count, some articles were modified and shortened in length. News

articles from CNN have been used as measures of discourse production in previous research on Aphasia (Rogalski et al., 2013). Analysis of CNN article retells is described in detail below.

*Measures of reading ability.* The CNN articles mentioned above were also included in this study as a measure of oral reading abilities, specifically fluency, measured by the number of words correct per minute (WCPM), rate, measured by the number of words read per minute (words/minute), and accuracy, the percentage of words read correctly (%WC).

The Gray Oral Reading Tests- 5<sup>th</sup> Edition (GORT-5) is a standardized assessment developed to measure oral reading abilities, including rate, accuracy, and fluency in children ages 6;0 to 23;11 (Wiederholt & Bryant, 2012). Although the GORT-5 is typically used for the school-age population, it was included in this study as a measure of change in oral reading ability from pre-testing to post- and follow-up testing. Wiederholt and Bryant (2012) report strong test-retest reliability for the GORT-5 ( $r = .82-.90$ ), and a SEM of one for rate, accuracy, and fluency and a SEM range of two to four for the oral reading index, indicating good test-retest reliability. This assessment contains multiple versions, which were used during this study.

The Psycholinguistic Assessment of Language Processing in Aphasia (PALPA) is a standardized assessment battery designed to evaluate language-processing impairments in people with aphasia (Kay, Lesser, & Coltheart, 1992). Subtest number 56 of the PALPA was administered to participants in order to assess sentence-level reading comprehension via picture matching. Comprehension of a variety of

grammatical constructs is examined, including reversible and non-reversible, active and passive, directional and non-directional, and gapped sentences.

*Measures of reading comprehension.* Two measures of reading comprehension were examined in this study: the comprehension score of the Gray Oral Reading Tests-5<sup>th</sup> Edition (GORT-5; Wiederholt & Bryant, 2012) and the reading subtest of the Western Aphasia Battery Revised (WAB-R; Kertesz, 2006). The comprehension score of the GORT-5 is comprised of the number of open-ended questions that the participant answers correctly. These items are passage dependent. The reading subtest of the WAB-R contains tasks such as comprehension of sentences, reading commands, written word-object matching, and others.

*Measures of cognition.* The Speed and Capacity of Language Processing Test (SCOLP) is a standardized assessment used to measure cognitive slowing associated with brain-dysfunction or injury (Baddeley, Emslie, & Smith, 1992). This assessment is comprised of two subtests: the Speed of Comprehension test, which provides information on processing speed, and the Spot-the-Word test, a lexical decision task. Multiple versions of this assessment are available and were used in this study.

The Test of Everyday Attention (TEA) is a standardized assessment used to measure various aspects of attention, defined by eight specific subtests (Robertson, Ward, Ridgeway, & Nimmo-Smith, 1994). Aspects of attention measured on the TEA include selective and sustained attention, attentional switching, and auditory-verbal working memory. Chen, Koh, Hsieh, and Hsueh (2013) reported that all TEA subtests, with the exception of the Telephone Search while Counting subtest, had good-to-

excellent test-retest reliability among all forms. Multiple versions of this assessment were used in this study.

*Measures of social validation.* The Comprehension and Communication Survey (CCS; Rogalski et al., 2013) is an informal, non-standardized measure included in this study in order to assess participants' perception of their ability to comprehend and express information across multiple communication situations. Participants rated their level of difficulty on a 5-point Likert Scale in eight different scenarios. A rating of one on the Likert Scale is associated with a very hard level of difficulty and a five is associated with a very easy level of difficulty.

Throughout this study, anecdotal evidence of participants' and communication partners' perception of improvement was collected via conversations during post treatment testing and in subsequent meetings.

### **Intervention procedure**

The current study followed a single-subject design to evaluate the effects of an intensive oral reading treatment. Each of the two participants served as his or her own control when determining if change was due to treatment. Throughout the course of treatment, probes were administered daily to assess treatment effects and generalization to discourse.

Multiple aspects of the studies previously discussed were incorporated into the design of the current study. The procedure was delivered following the basic guidelines presented by Rogalski and Edmonds (2008) for Attentive Reading and Constrained Summarization (ARCS) treatment, which requires subjects to orally read then

summarize portions of a reading passage while refraining from the use of nonspecific or vague language. However, in the current study we modified the procedure by reading the whole text aloud instead of 2-3 sentences at a time and eliminated silent rereading for comprehension. Oral Reading for Language in Aphasia (ORLA; Cherney et al., 1986; Cherney 2010b) incorporates multimodal stimulation (visual-written in addition to verbalizing aloud) and repeated exposure to texts with the clinician reading aloud with the participant. These aspects of treatment were integrated into the current study, with the exception that the clinician read aloud with the participant to correct errors only when necessary. Several features of Intensive Language Action Therapy (ILAT; Difrancesco, Pulvermüller, & Mohr, 2012) were implemented throughout this treatment study, including the constraint of communication to the verbal modality and an intensive dosage administered over a short period of time. Language activities were utilized in the current study, but were not the exact “language-action” games described by Difrancesco and colleagues (2012). Rather, tasks that emphasized oral reading were implemented.

*Stimuli.* Treatment stimuli consisted of two distinct sets of materials with a focus on oral reading. The first set of stimuli materials included 15 CNN articles, as described in detail above. Articles were presented on letter-sized (8.5” x 11”) white paper in black, size 14 Arial font. One to two CNN articles were presented for training throughout each day of intervention. First, participant one read the CNN article aloud with the clinician jumping in to correct reading errors when necessary. Then, he or she summarized the text and participant two, who had been listening to the reading, filled in information missing from participant one’s retell. After, the clinician corrected errors in the retells and determined if information was still missing. If it was, participant two re-read and

summarized the same text. Then, participant one was allowed to fill in missing information as necessary. Finally, the clinician filled in any remaining information and reviewed the written text if needed.

The second set of stimuli materials included seven short, one-act plays with two to four roles in each chosen at random from *The Best Ten-Minute Plays 2012* (*Contemporary Playwrights Series*) and an Internet search. Identical plays were provided to each participant printed in black ink, on white letter-sized (8.5" x 11") paper. One play was read every 1-2 days throughout the course of treatment. During the play-reading task, each participant assumed one role and the script was read as group, as if performing the play. Afterwards, participants were asked comprehension questions presented on computer in a "Jeopardy" style format, placed 2-3 feet from where they were seated. They took turns choosing from 12 questions, reading them aloud, and answering. Topics of the comprehension questions were related to characters, events, and settings specific to each play. After all comprehension questions were answered, incorrect responses were reviewed and corrected by the other participant when possible. If not, participants were given contextual cues to and finally were directed to re-read the section of the play to locate the correct answer, when necessary.

*Treatment and generalization probes.* The CNN articles and Norman Rockwell pictures previously described were used to assess oral reading and discourse performance. Prior to treatment, three baseline probes were administered to participants to test accuracy, fluency and rate of oral reading as well as productivity, informativeness and efficiency of discourse production during summarization (treatment probes). Probes were also administered to assess narrative discourse during picture

descriptions (generalization probes). Stable baselines were achieved in discourse informativeness for each participant, as this was the study's main outcome measure, and thus the focus of treatment. Therefore, although other baselines were not necessarily stable, it was decided that treatment could begin.

For the 10-day duration of intervention, treatment and generalization probes were administered on alternate days before treatment sessions began in order to characterize variability and trends over time, so each type of probe was administered after every 6 hours of treatment. The treatment probe (trained news articles) trained during the previous session and one generalization probe (picture description) were administered together on the same days and on alternate days, the second generalization probe was administered (untrained news articles).

*Intervention.* Treatment was conducted for 3 hours per day for a duration of 2 weeks (10 days). Multiple principles from previous treatment studies were included in the protocol of the current study, including the summarization of text read aloud while refraining from the use of nonspecific language (ARCS; Rogalski & Edmonds, 2008), multimodal stimulation and repeated exposure to texts (ORLA; Cherney 2010b), as well as constraints on nonverbal communication and an intensive treatment dosage (ILAT; Difrancesco et al., 2012). Each daily group treatment session was divided into two activities: 1) reading aloud and subsequent summarization of news articles, and 2) reading plays aloud and reading and answering comprehension questions. Treatment sessions went as follows:

During the first activity, CNN articles were orally read and trained, similar to the ARCS procedure (Rogalski et al., 2013) detailed above. In the latter half of the

treatment session, participants were assigned one role within the short plays, the play was read aloud as if it being performed, and then participants answered comprehension questions regarding the text, as detailed previously. It should be noted that the use of plays was not a part of the ARCS protocol (Rogalski et al., 2013), though they were included in the current study because the reading level was similar to that of the CNN articles. Additionally, the emphasis on auditory comprehension and the need to relay specific details was the same for the plays as it was for the CNN articles.

*Treatment data analysis.* In the current study, responsiveness to intervention was examined on an individual basis, based on a combination of measures acquired pre-treatment, during treatment, and post-treatment. Outcome variables examined include 1) change in performance on standardized assessments, 2) changes in discourse efficiency, informativeness, and productivity for trained and untrained materials, and 3) changes in accuracy, rate, and fluency of oral reading.

Measures of change in performance on standardized assessments were compared across three time intervals: pre-treatment, post-treatment, and follow-up (see Figure 1). Changes following intensive aphasia treatments tend to continue past the completion of treatment and with additional gains on standardized batteries documented up to one-month post-treatment (Johnson, et al., 2014; Mozeiko, et al., 2015; Szaflarski et al., 2008). Therefore, results of these assessments were analyzed by calculating the maximum percent change from pre-treatment values to either post-treatment or follow-up values, whichever measure was highest. To determine if changes on assessments were clinically significant, the following guidelines were used: five points or greater on

the WAB-R and a 10% or greater change on other assessments when not specified otherwise (Katz & Wertz, 1997).

Measures of pre- to post- treatment change in discourse production were elicited from three tasks: untrained Norman Rockwell picture descriptions, trained CNN article retells, and untrained CNN article retells.

Participants' trained and untrained article retell probes were analyzed for both informativeness and efficiency. Retells were video recorded and later transcribed verbatim into Microsoft Word to obtain word counts. Timing information collected from the recordings was added to the transcripts. After transcription, word counts and Correct Information Units (CIUs: the number of intelligible and relevant words), used to measure discourse production, were obtained using the procedures outlined by Nicholas and Brookshire (1993). This information was then used to calculate three measures of discourse productivity, efficiency and informativeness: total number of CIUs, CIUs per minute, and percent CIUs.

Participants' descriptions of Norman Rockwell prints were used as a measure of generalization to narrative discourse. Picture descriptions were video recorded and later transcribed verbatim. Using the Nicholas and Brookshire (1993) procedure detailed above, picture descriptions were analyzed for CIUs to measure productivity of narrative discourse (total number of CIUs). CIUs per minute and percent CIUs were also calculated as measures of discourse efficiency and informativeness.

Effect sizes for discourse production and reading measures were calculated from values taken at pre-treatment, post-treatment, and follow-up testing, according to the  $d$  statistic detailed by Busk and Serlin (1992, pp. 197-198). This statistic requires

subtracting the mean of the baseline probes from the mean of the two final probe values, then dividing the result by the standard deviation of the baseline scores. The strength of effect sizes were based on the following benchmarks: small= 4, medium= 7, large= 10 (Beeson & Robey, 2006).

Measures of change in oral reading performance were also examined across all three time intervals. Reading errors were counted in real time, as participants read the untrained CNN articles aloud, and were used to calculate accuracy (percentage of words read correctly). Reading errors included any deviation from the print, with the exception of obscure or uncommon proper nouns and self-corrections. Additionally, variables of fluency, rate, and accuracy were examined. To calculate fluency, the number of errors produced during oral reading was subtracted from the total number of words read, to get the number of words read correctly (accuracy). Then, the number of words read correctly was divided by the time (in minutes) it took to complete the reading, thus giving a fluency calculation of words correct per minute (WCPM). Rate was calculated by dividing the number of words by the number of minutes it took to complete the reading (words/minute) and accuracy was measured by the percentage of words read correctly (%WC).

## **Results**

It was predicted that the intensive oral reading program detailed above would result in increases in discourse and also in reading performance. These were assessed using the following outcome measures 1) narrative discourse (productivity, efficiency, informativeness) 2) article retell informativeness 3) accuracy, rate and fluency of oral reading 4) aphasia batteries 5) the Gray Oral Reading Tests- 5<sup>th</sup> Edition (GORT-5) and reading subtests of the WAB-R 6) cognitive assessments, and 7) a self-rating of reading performance. The data are reported in Tables 2-3.

**Table 2.** Pre-, post-, and follow-up treatment, and maximum percent change results from standardized measures for both participants

Test/Measure	P1			P2		
	Pre-Tx	Post-Tx	Follow-up	Pre-Tx	Post-Tx	Follow-up
<b>Language</b>						
WAB-R AQ (% correct)	75.3%	80.8%	82.0%	91.5%	92.0%	94.2%
BNT (% correct)	48.3%	76.7%	66.7%	80.0%	85.0%	86.7%
PALPA- Subtest 56 (% correct)	75.0%	80.0%	71.7%	85.0%	81.7%	88.3%
DCT (% correct)	67.5%	60.0%	55.0%	90.0%	82.50%	90.0%
<b>Cognition</b>						
SCOLP- SC (% correct)	20%	20%	27%	25%	33%	28%
TEA						
MS (2-minute scaled score)	9	7	12	3	n/a	3
EC (raw score)	5	6	6	7	7	7
ECWD (scaled score)	4	n/a	7	7	8	11
VE						
Accuracy (scaled score)	7	n/a	7	8	9	11
Timing (scaled score)	2	n/a	n/a	3	n/a	3
ECWR (scaled score)	5	5	6	12	7	13
TS (scaled score)	7	6	8	3	n/a	6
TSWC (scaled score)	4	2	4	4	11	8
Lottery (scaled score)	2	n/a	2	3	n/a	4
<b>Reading</b>						
WAB-R reading subtest (% correct)	77.0%	84.0%	98.0%	100.0%	n/a	n/a
GORT-5 (raw scores)						
Rate	14	12	13	14	13	14
Accuracy	17	18	20	24	35	38
Fluency	31	30	33	38	48	52
Comprehension	12	18	24	25	29	40
<b>Social Validation</b>						
CCS (average % score)	50.0%	62.0%	65.0%	70.0%	70.0%	70.0%

**Note.** P1= participant 1, P2= participant 2. All raw scores converted to percent correct, when possible. WAB-R= Western Aphasia Battery Revised (AQ= Aphasia Quotient), BNT= Boston Naming Test, PALPA= Psycholinguistic Assessment of Language Processing in Aphasia (Subtest 56: Written Sentence Comprehension), SCOLP-SC= Speed and Capacity of Language Processing Test (Speed of Comprehension Subtest), TEA= Test of Everyday Attention (MS= Map Search, EC= Elevator Counting, ECWD= Elevator Counting with Distraction, VE= Visual Elevator, ECWR= Elevator Counting with Reversal, TS= Telephone Search, TSWC= Telephone Search while Counting), DCT= Discourse Comprehension Test, GORT-5= Gray Oral Reading Tests- Fifth Edition, CCS= Comprehension and Communication Survey. \*5 points on the Western Aphasia Battery is considered clinically significant (Katz & Wertz, 1997), \*\*10% or greater change is considered clinically significant when not otherwise specified (Katz & Wertz, 1997).

**Table 3.** Pre-, post-, and follow-up treatment, and effect sizes from treatment and generalization probes for both participants

Measure	P1			P2		
	Pre-Tx	Post-Tx	Follow-up	Pre-Tx	Post-Tx	Follow-up
<b>Narrative Discourse</b>						
<i>Picture Descriptions (untrained)</i>						
Efficiency (CIUs/Minute)	73.1	80.9	95.1	53.0	49.3	44.5
Informativeness (%CIUs)	59.0%	62.0%	69.0%	47.0%	60.0%	62.0%
Productivity (total # CIUs)	44.3	126.3	101.2*	66.4	53.1	54.5
<i>Article Retells</i>						
Trained						
Efficiency (CIUs/Minute)	33.8	34.8	43.0	21.6	17.8	38.8
Informativeness (%CIUs)	27.0%	42.0%	45.0%	28.0%	36.0%	62.0%
Productivity (total # CIUs)	53.3	109	59.5	78.7	82.0	112.0
Untrained						
Efficiency (CIUs/Minute)	33.8	32.0	41.5	21.6	10.6	32.6
Informativeness (%CIUs)	27.0%	42.0%	44.0%	28.0%	24.0%	47.0%
Productivity (total # CIUs)	53.3	83.0	68.5	78.7	28.5	141.0
<b>Oral Reading</b>						
<i>Trained Probes</i>						
Accuracy (%WC)	78.3%	82.1%	86.7%	95.5%	94.6%	98.0%
Rate (words/minute)	54.9	45.7	59.0	46.4	46.9	49.7
Fluency (WCPM)	46.6	37.5	51.0	44.4	44.4	48.6
<i>Untrained Probes</i>						
Accuracy (%WC)	78.3%	80.6%	88.4%	95.5%	94.8%	96.7%
Rate (words/minute)	54.9	43.1	55.1	46.4	39.0	45.4
Fluency (WCPM)	46.6	34.8	49.3	44.4	36.0	43.1

**Note.** P1= participant 1, P2= participant 2, % CIUs= percentage of CIUs compared to total words, %WC= percentage of words read correctly, WCPM= words correct per minute.  
\*Clinically significant increase according to both visual inspection and an effect size of at least 4 (benchmarks provided by Robey and Beeson, 2006).

## P1's results

P1 made gains across most outcome measures. These gains were most pronounced in standardized assessments, including the WAB-R, BNT, TEA, Speed of Comprehension subtest of the SCOLP (SCOLP-SC; Baddeley et al., 1992), GORT-5, and one measure of narrative discourse. No improvements were observed on the PALPA, and accuracy, rate and fluency of oral reading probes.

*Discourse.* On the trained article retells, P1 exhibited pre-treatment measures of 33.8 CIUs/minute, 27% of CIUs to total words, and 53.3 total CIUs. Her efficiency,

measured by the number of CIUs/minute, increased to 43.03 at follow-up. Her informativeness, the percentage of CIUs compared to total words (%CIUs), also increased to 45% at follow-up and her productivity, measured by the total number of CIUs, increased to 109 post-treatment and then dropped to 59.5 at follow-up. Although increases are noted in maximum percent change, they are not clinically significant according to effect size.

These results are similar to those exhibited on the untrained article retells in that maximum percent changes were present for all measures, although they are not considered clinically significant according to effect size. P1's efficiency increased from 33.8 CIUs/minute at pre-treatment testing to 41.5 at follow-up. Again, increases were seen on informativeness, as this measure changed from 27% CIUs at baseline to 44% CIUs at follow-up. P1's productivity increased from 53.5% CIUs at pre-treatment to 68.5% at follow-up.

P1's performance on discourse generalization probes (Rockwell picture descriptions) consistently improved on one measure: productivity (see Table 3). She exhibited clinically significant increases that were predominantly maintained at follow-up, evidenced by a large effect size (37.4). Visual inspection reveals a significant upward trend of total CIUs (see Figure 3), which increased from 44.3 total CIUs at baseline to 101.2 at follow-up. Her efficiency of retells increased from 73.1 CIUs/minute at pre-treatment testing to 80.9 post-treatment, and 95.1 at follow-up. Her informativeness increased from 59% CIUs at pre-treatment to 62% at post-treatment, and 69% at follow-up. Although these measures increased, no significant effect sizes

were exhibited for efficiency and informativeness, and visual inspection revealed insignificant changes.

*Oral reading.* P1's oral reading performance on the trained CNN articles showed minimal change in accuracy, from 78.3% words correct at pre-treatment to 86.7% at follow-up. Her rate remained similar across visits, from 54.9 words/minute at pre-treatment testing to 59 words/minute at follow-up, as well as her fluency, from 46.6 WCPM to 51 at follow-up. No clinically significant changes were evident for accuracy, rate, or fluency according to effect sizes. Visual inspection of Figure 3 revealed no changes in slope for all measures.

P1's performance on the untrained CNN articles showed very similar patterns to the trained probes. Overall, her rate of oral reading remained the same, from 54.9 words/minute at pre-treatment testing to 55.1 words/minute at follow-up. Likewise, she demonstrated a fluency measure of 46.6 WCPM at baseline, which remained relatively the same at follow-up (49.3 WCPM), and accuracy of oral reading increased from 78.3% words correct at baseline to 88.4% at follow-up. However, according to effect sizes, no clinically significant changes were present for any of these measures.

*Language assessment.* P1 demonstrated clinically significant gains on two language measures (see Table 2). She demonstrated steady improvement, measured at 8.9% maximum change, on the aphasia quotient (AQ) composite score of the WAB-R. Additionally, P1 exhibited gains on the BNT, from 48.3% correct at baseline to 76.7% correct at post-treatment. Both gains were maintained over time. Even though they dropped slightly on the BNT at follow-up these scores remained 18.4% above pre-treatment scores, which is still a substantial gain. P1's performance on the DCT

decreased significantly, from 67.5% correct at pre-treatment, to 55% correct at follow-up.

*Cognitive assessment.* As evidenced in Table 2, P1 made clinically significant gains on several subtests of attention within the TEA, including the Map Search, Elevator Counting, Elevator Counting with Distraction, Elevator Counting with Reversal, and Telephone Search. She also exhibited clinically significant improvement on the SCOLP-SC as her scores increased from 20% correct at baseline to 27% correct at follow-up. All of these improvements were maintained at follow-up.

*Reading assessment.* P1 demonstrated clinically significant improvements in accuracy and comprehension, as measured by the GORT-5. Her accuracy performance improved from a raw score of 17 at baseline to 20 at follow-up. Her comprehension steadily increased from a raw score of 12 at baseline to 24 at follow-up. Additionally, P1 exhibited clinically significant gains on the reading subtest of the WAB-R, as her score changed from 77% correct at baseline to 98% correct at follow-up.

*Social validation.* P1's average self-assessment ratings on the CCS steadily increased from 50% at pre-treatment assessment, to 62% at post-treatment assessment, and finally to 65% at follow-up. On numerous occasions throughout the study, P1's spouse mentioned that his wife "sounded better". Additionally, P1 told the authors of the study that she felt she could now read a news article and explain the content to her friends, a task that presented much difficulty for her prior to this intervention.

## **P2's results**

P2's results on standardized and non-standardized measures varied somewhat from P1. His most prominent changes were exhibited on the TEA, GORT-5, and SCOLP-SC. No clinically significant gains were exhibited on the remaining assessments or measures of oral reading and discourse production. However, it should be noted that P2 was close to ceiling levels on several of these measures.

*Discourse.* P2 did not exhibit clinically significant changes in efficiency, informativeness, and/or productivity of trained article retells. Although increases in maximum percent change are present for all measures, effect sizes revealed no clinically significant difference (see Table 3).

Changes exhibited on untrained article retells follow a very similar pattern to trained article retells. P2 demonstrated gains in maximum percent change across all three measures: 50.9% increase in efficiency, 67.9% in informativeness, and 79.2% in productivity. However, again, effect sizes did not reveal clinically significant changes in any measure of discourse.

Similar to the above discourse measures, P2's gains in informativeness of untrained picture descriptions were minimal, from 47% CIUs at pre-treatment to 62% at follow-up. His efficiency and productivity both decreased. P2's efficiency showed a maximum percent change of -7% and productivity decreased from 66.4 total CIUs at pre-treatment to 54.5 at follow-up, a -17.9% maximum percent change. Effect sizes and visual inspection of Figure 2 revealed no clinically significant changes in the above measures of generalization.

*Oral reading.* P2's accuracy, rate, and fluency of trained CNN articles remained relatively similar from pre- to post-treatment. His maximum percent changes for

accuracy and rate were 2.6% and 7.1%, respectively. P2's changes in fluency were slightly higher, at 9.5%, though still clinically insignificant. Visual inspection of Figure 3 and effect sizes revealed no changes in slope for accuracy, rate, or fluency.

Similar to his performance on the trained article probes, P2 exhibited comparable pre- and post- treatment values across all measures of oral reading of untrained CNN articles. No clinically significant changes were evident in accuracy, rate, or fluency of oral reading of untrained articles.

*Language assessment.* As highlighted in Table 2, P2 exhibited no clinically significant gains on measures of language, including the BNT, PALPA, and DCT. His aphasia quotient (AQ) composite on the WAB-R remained similar over time, though it should be noted that P2 scored high on this test at baseline (91.5% correct).

*Cognitive assessment.* P2 demonstrated clinically significant gains on several subtests within the TEA, including the Elevator Counting with Distraction, Telephone Search, Telephone Search while Counting, Lottery, and Visual Elevator (see Table 2). P2 also exhibited important gains on the Speed of Comprehension subtest of the SCOLP, as his score improved from 25% correct at baseline to 33% at post-treatment.

*Reading assessment.* P2 made clinically significant gains on three of the four measures of the GORT-5, detailed in Table 2. Specifically, his accuracy, fluency, and comprehension scores improved. Gains on the GORT-5 were maintained at follow-up. It should be noted that P2 experienced a ceiling effect on the reading subtest of the WAB-R, as he scored 100% correct at baseline.

*Social validation.* P2's average self-assessment ratings on the CCS remained steady, at 70% across all testing periods. He did not mention any meaningful gains in

his reading, but did indicate that he did not focus as much on his word finding difficulties during conversation post-treatment, which took a significant amount of time and was distracting to his communication partner.

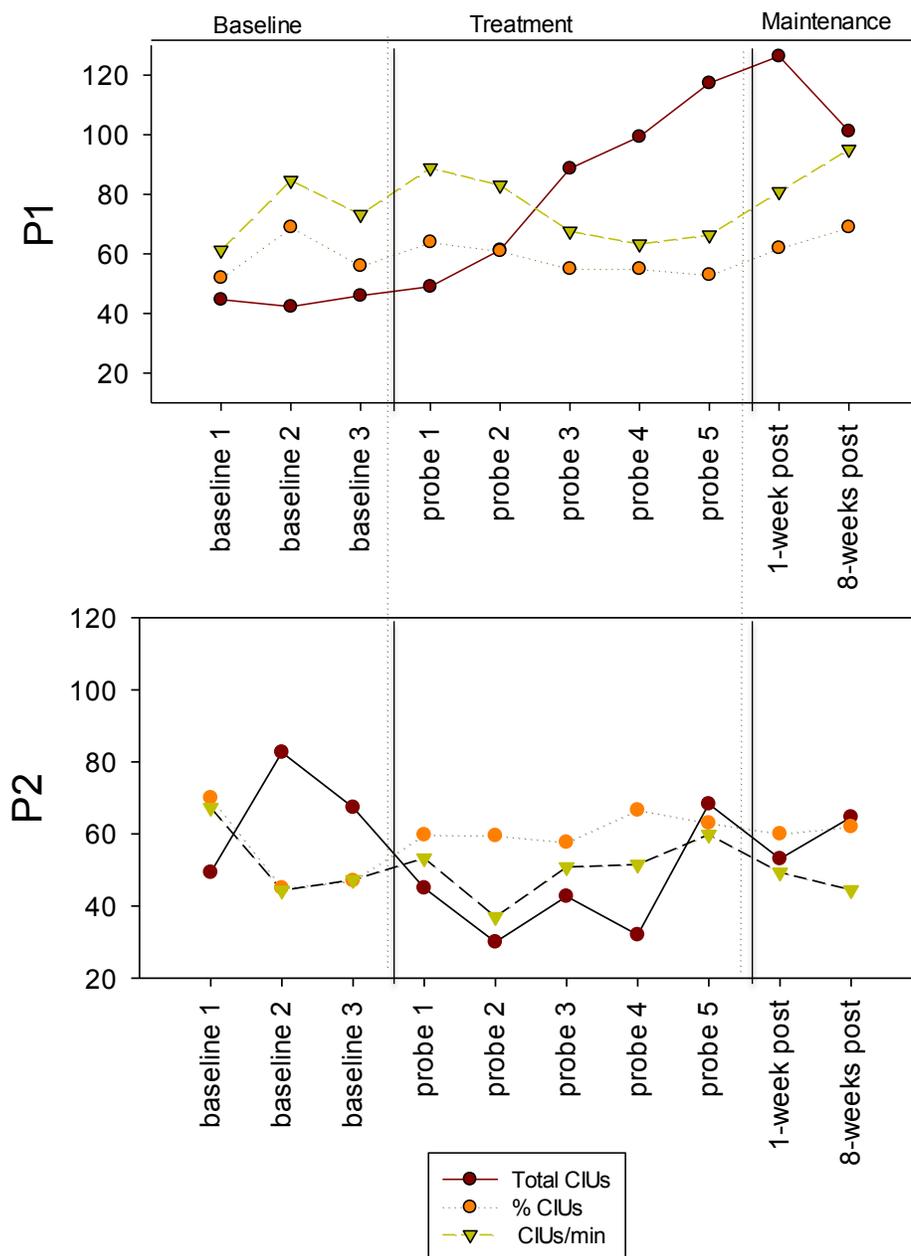
## **Summary**

The clinically significant results of this treatment study are noted via asterisks in Tables 2-3. Each participant made gains in numerous measures though, on numerous occasions, both subjects exhibited improvements in the same area.

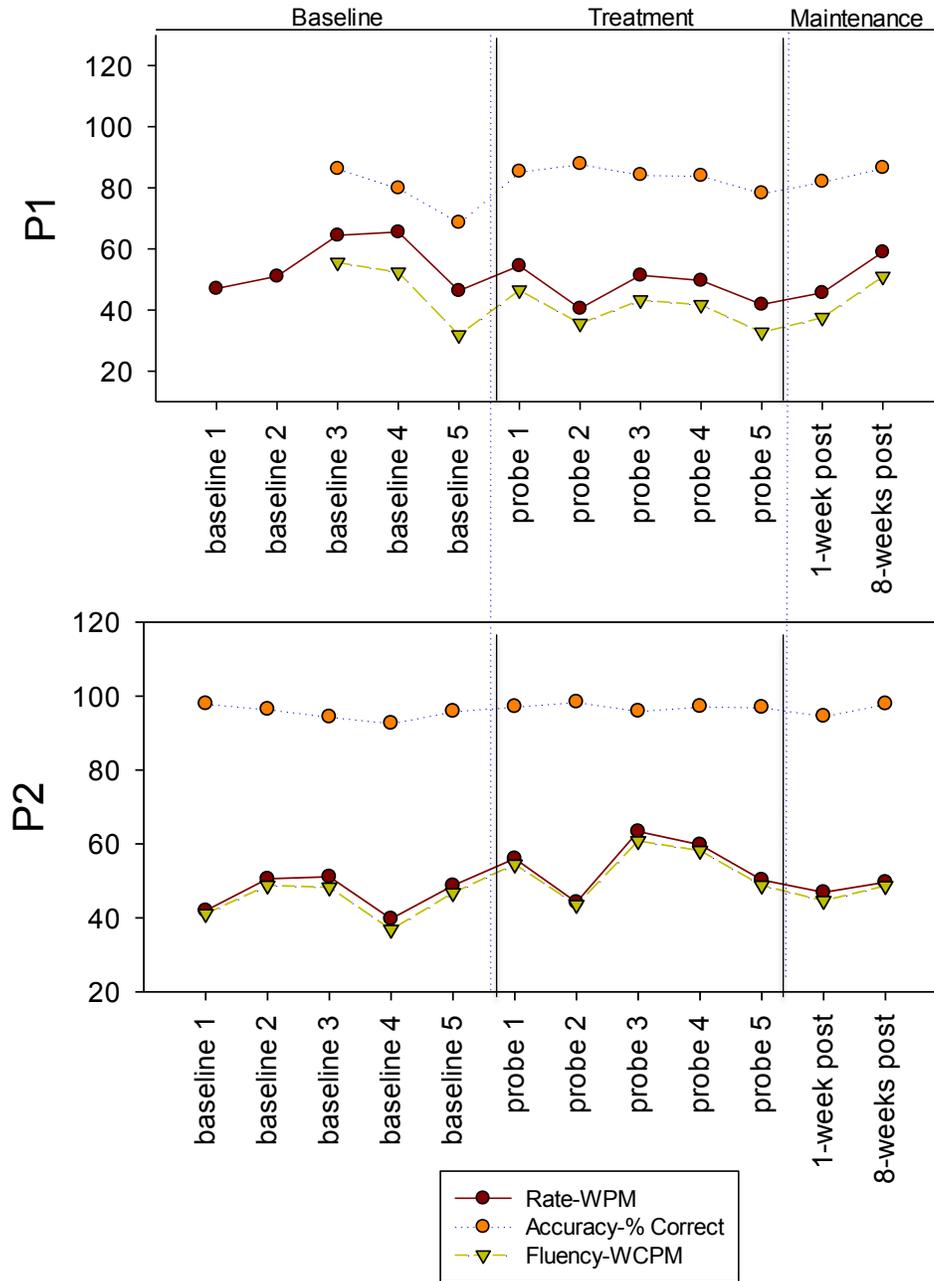
P1 and P2 each made progress on the following measures: subtests of the TEA, measures of the GORT-5, and the Speed of Comprehension subtest of the SCOLP. P1 made additional gains on other measures of language, social validation, reading comprehension, and discourse productivity of untrained picture descriptions.

Participant variability in the results of this study is apparent, as has been the case in past aphasia research. Participants' responses to this oral reading program will be discussed separately, with reference to the impact of individual differences on treatment outcome.

**Figure 2.** Narrative discourse generalization probes (untrained picture descriptions)- productivity, informativeness, and efficiency for both participants.



**Figure 3.** Oral reading probes (trained articles)- rate, accuracy, and fluency for both participants.



## Discussion

Research on the deficits and treatments specific to chronic mild aphasia is limited, likely because interventions for aphasia have been geared towards people with greater levels of language impairment, as these symptoms are often glaring and debilitating. However, PWMA have the best potential chance of successfully returning to work and rebuilding social networks and thus should not be overlooked in the literature. Therefore, designing an intervention specific for individuals with mild aphasia was the basis of the current study. As previously discussed, discourse and reading are both aspects of language severely affected by aphasia and are both areas in which many PWA struggle. The few studies that have investigated oral reading treatments in PWA include ARCS (Rogalski & Edmonds, 2008) and ORLA (Cherney et al., 1986; Cherney 2010b) methods. However, PWMA were not included in ARCS and although 10 people with mild-moderate aphasia were included in ORLA (Cherney, 2010b), they were not the target population. The current study was designed specifically for use with PWMA by increasing the level of difficulty with the use of more challenging treatment stimuli than ORLA and by using the ARCS protocol of limiting the use of vague and non-specific language (Cherney, et al., 2010b; Rogalski et al., 2013). Additionally, the current study incorporated aspects of CILT (Pulvermüller et al., 2001) thought to contribute to treatment success including an intensive dose, utilizing therapeutic language games, and implementing treatment in a group format.

The purpose of this study was to examine the effect of an intensive oral reading program on discourse efficiency, informativeness, and productivity in participants with chronic mild aphasia. A secondary purpose of this study was to investigate the impact of

this program on oral reading skills, specifically accuracy, rate, and fluency. In addition, potential effect on reading comprehension was investigated.

We hypothesized that this intensive oral reading program would result in increases on narrative discourse measures, as well as increases in the rate, accuracy, fluency and comprehension of oral reading. In addition to investigating discourse and oral reading, other outcome measures were examined. These include standardized language and cognitive assessments and social validation measures.

Hypotheses were supported for P1, who demonstrated modest increases on several outcome measures. Improvements were observed in discourse productivity (total CIUs) of generalization probes (Rockwell picture descriptions). She also exhibited increases in accuracy of oral reading as well as reading comprehension. Hypotheses were partially supported for P2, with a strong treatment response for reading as measured by the GORT-5 and on measures of attention. Differences in treatment outcomes may be due to individual factors of the participants.

## **P1 discussion**

P1's gains in assessments, discourse, and oral reading measures indicate a positive response to this intensive oral reading program. Her gains in cognitive assessments (SCOLP-SC and TEA) indicate that this treatment targeted not only conversational discourse and reading, but generalized to broader aspects of cognitive-linguistic processes, including attention. In the current study, oral reading training appears to have improved selective and sustained attention as well as other areas. In contrast, Coelho (2005) and Sinotte and Coelho (2007) demonstrated improvement in

reading as a result of attention training. Although each of these studies reports gains from only 1-2 participants, the results are consistent and provide additional evidence to the literature pointing to the interrelatedness of language processing and attention (Crosson, 2000; Murray, 1999). It remains to be seen whether training one over the other might produce better outcomes.

P1's gains in reading, evidenced by increases in comprehension and accuracy on the GORT-5, is an extremely functional benefit of treatment for this participant, as prior to her stroke she belonged to book clubs and enjoyed the socialization aspect of these groups. Her ability to accurately read, comprehend, and fluently express her thoughts and ideas would allow her to rejoin these social activities, and as social isolation is a common feeling among PWA, this treatment would reverse this negative effect. Furthermore, improvements in comprehension will likely lead to an increase in willingness to read, a task that many PWA find daunting. By decreasing the frustration associated with poor understanding of written material, there is a better likelihood of returning to read, which should result in increased function over time.

Although P1 did exhibit clinically significant changes on reading measures according to the GORT-5, no meaningful improvements were seen in oral reading of treatment probes. Because of this discrepancy, it raises the question that these differences may be due to the measures themselves- perhaps the GORT-5 was a more sensitive measure and the treatment probes were not able to pick up on the same changes. Additionally, P1 may have only been capable of making changes in accuracy of oral reading, and not rate or fluency, because of her reduced reading comprehension overall. It can be argued that reading comprehension precedes production of oral

reading, so P1 may have to continue to make improvements receptively before she can make additional gains expressively.

P1 also exhibited clinically significant gains in productivity of narrative discourse production in untrained picture descriptions, as evidenced by a large effect size (37.4). The improvement in productivity, and not efficiency or informativeness, is a logical first step in the remediation of discourse. Before efficiency and informativeness can improve, the amount of meaningful information (productivity) needs to increase. Then, after sufficient information is present, the rate that meaningful information is conveyed (efficiency) and the proportion of relevant information produced (informativeness) can be refined in subsequent stages of the rehabilitation process. P1 made positive changes on one measure of generalization, indicating that improvements in discourse production may be likely to continue to improve on other untrained materials, unrelated to those presented in treatment. Additionally, this improvement in discourse may enhance her quality of life. People are frequently judged by their ability to articulate ideas, which is considered a reflection of intelligence. In aphasia, though, there is a disconnect—cognitive abilities are usually, relatively intact, though deficits in discourse can give the impression that cognitive status is worse than it is. Therefore, improving narrative discourse can result in improved quality of life, as many PWA report feeling they are viewed as cognitively impaired and improving discourse would counteract the viewpoint of others. Decreasing errors and increasing the content of messages, to better present ideas, may lead to achievement of the ultimate goals: regaining employment and improving socialization.

Additionally, her clinically significant increases on the WAB-AQ are important

because this is a good measure of severity and research has demonstrated that WAB-AQ score are correlated with quality of life issues related to communication (Williamson, Richman, & Redmond, 2011). Therefore, it can be assumed that if improvements are made on the AQ, an individual's feelings of reduced quality of life may be reversed. P1's 15% increase on the CCS indicates that not only did she make numeric improvements as a result of treatment, but that these changes positively influenced her life which, arguably, is one of the most important factors to consider in choosing a treatment method.

## **P2 discussion**

P2's response to treatment was characterized by marked improvement on measures of reading comprehension, accuracy and fluency on the GORT-5 as well as changes on five subtests of the TEA. Although P2 did not make gains on quite as many outcome measures as P1, the improvements he exhibited indicate a positive response to intervention. This is very interesting, as this participant completed 60 hours of intensive treatment the year before and this outcome indicates improvements in language above post-treatment scores at that time. In addition, it is important to note that P2's pre-treatment scores were all higher than P1's, often near ceiling, which again would likely influence total amount of improvement.

P2 did demonstrate meaningful improvements, most notably in his performance on the accuracy, fluency, and comprehension scores of the GORT-5. All of these areas continued to increase between the end of treatment and the 8-week follow-up. These gains support our theory that oral reading improved as a result of treatment. It should be

noted that there are two versions of the GORT-5 and that different versions were used immediately post and 8-weeks post, making it less likely that the additional gains were due to previous exposure to this test. In contrast to P1's performance on oral reading, P2's meaningful changes in both accuracy and fluency may be due to the fact that his comprehension was much better at baseline. It can be argued that because he was receptively more intact he may have been more prepared to make changes expressively. As discussed above, these improvements in oral reading may lead to multiple positive changes in quality of life. Most importantly to P2, in particular, is the ability to function independently and successfully return to work. Both of these desires are more likely to be achieved if reading abilities improve. Similar to the discussion introduced previously, P2's improvements in attention point to an interrelatedness of language processing and attention, which is consistent with what has been found in previous literature (Crosson, 2000; Murray, 1999).

Both P1 and P2 demonstrated clinically significant changes in reading comprehension as measured by the GORT-5 and/or the reading subtest of the WAB-R. These findings are of particular interest because previous studies have shown improvements in reading comprehension only in participants with moderate to severe aphasia (Cherney, 2010a; Cherney, 2010b; Cherney et al., 1986) and the effect of ARCS on reading comprehension has not been investigated in previous studies (Rogalski & Edmonds, 2008; Rogalski et al., 2013). It can be argued that P1 and P2 made improvements in this area that were not evident in previous studies because the repetition provided in ORLA (Cherney, 2010a) was not enough to aid in comprehension for milder participants, even though it may have worked for people with greater levels of

severity. The high intensity treatment dosage of the current study likely contributed to participants' improvement in reading comprehension, as this provided multiple hours of reading and repeated opportunities for reinforcement of comprehension each day instead of a few hours per week. Additionally, the game format of the current study, which offered motivating listening opportunities to participants because they earned points for answering comprehension questions correctly, may have pushed our milder participants enough to enhance performance.

As mentioned previously, P2 participated in 60 hours of intensive CILT treatment one year prior to the current study. This may account for the reason he did not make any clinically significant changes in discourse production, as he may have theoretically reached his potential as a result of all the previous intervention. It may be possible that P2's discourse samples from article retells and picture descriptions are now within what would be considered a "normal" range when compared to non-brain-injured adults. Thus, we would not see improvements in this area because he has reached his potential, or what would be "normal." However, as of now, there are no normative samples for the Rockwell picture descriptions and CNN article retells to make these comparisons, so this is an area in need of future research.

Interestingly, P2's discourse productivity (total CIUs) for generalization probes actually decreased significantly while his informativeness consistently increased. In other words, he likely started to decrease the overall length of his picture descriptions (which would decrease his total CIU count), but the information he did include was meaningful (increasing his overall informativeness). Also, P2's scores on the DCT stayed the same from pre-treatment to follow-up, and P1's decreased, suggesting that

comprehension did not generalize to aurally presented material for either participant. His results on the CCS indicate that he did not view this oral reading program to be beneficial in terms of quality of life and daily communication, though this is inconsistent with the improvements in oral reading he exhibited on the GORT-5.

### **Future research**

As evidenced above, the results of this intensive oral reading program demonstrate that treatment for PWMA is worth additional investigation, as the current literature is rather limited for this population. Modifications to the materials and procedures detailed within this study may improve participant performance in future research. Adding an additional measure of comprehension for reading might support the results from the GORT-5 and provide further evidence that this ability improves as a result of treatment. It would also be beneficial to acquire normative data on the Rockwell pictures in order to provide a basis of comparison to non-brain-injured adults. Most importantly, repeating this study with a larger number of participants with mild aphasia would provide a better understanding of the efficacy of this intensive oral reading program.

Additionally, the discrepancy between the strong results on the GORT-5 and weak results on oral reading probes indicate that inclusion of alternative reading materials, and/or additional measures of reading ability, should be included in future studies of intensive oral reading programs.

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