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Effects of a Novel Right Brain Intervention on Stuttering in Familiar and Structured Speech Tasks

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Effects of a Novel Right Brain Intervention on Stuttering in Familiar and Structured Speech Tasks

by

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DEDICATION

I wish to dedicate this thesis to my late mother, Rebecca, whose kindness, warm soul, and selfless generosity continue to inspire many. To my love, Chris, whose devotion to our family has made it possible for me to pursue my dreams and whose support has given me strength and confidence. To my daughter, Audreyana, whose smile, laughter, and presence continuously remind me of what life is all about. To my grandmother, Nedra, for fostering and encouraging my love of learning from an early age. To everyone in my amazing family and to all of my supportive friends, who have offered sound advice, incomparable friendship, and warm memories throughout the years. I would not be me without all of you.

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ABSTRACT

Over 3 million Americans are disfluent due to developmental stuttering. Current evidence-based treatments typically consist of a rigorous schedule of intensive therapy, followed by the need for maintenance of skills, placing high demands on self-monitoring of one's speech at all times. Relapse after treatment is very common, at 84%. The demand for further research into treatment possibilities for stuttering is on the forefront. Previous research has connected neural activations in people who stutter (PWS) and people with chronic nonfluent aphasia. The aim of this study was to determine if a novel intervention, based on a treatment for anomia, would change the frequency of stuttering during two speech tasks. A focal point of the treatment was the inclusion of a complex left-handed movement throughout tasks, targeting a proposed lateralization of neural activation into the right hemisphere of PWS, in order to promote fluent speech. Based on the results from the aphasia treatment study, a decrease in the frequency of stutter events was expected as a result of the adapted treatment for fluency. Two participants received treatment over the course of three weeks. Measurements of fluency during two speech tasks were obtained for pre-treatment, post-treatment, and follow-up analysis. Results from treatment indicated a general decrease in the frequency of stutter events in both participants. Further research is warranted in order to determine if this type of treatment could help to initiate a shift in focus to intervention approaches that deliver fluency gains with much less intensive treatment.

INTRODUCTION

Emerging research concerning the onset of developmental stuttering, the incidence and prevalence of the disorder, and treatments that deliver success, is constantly developing and changing the way we approach treatment for people who stutter (PWS). The typical range of onset for stuttering has been commonly placed within early childhood, although there are discrepancies among researchers when coming to a conclusion about the average age of onset. Inconsistencies may be due to a number of things including evidence that the majority of children who experience stuttering will spontaneously recover from disfluencies naturally, without formal intervention (Yairi & Ambrose, 1999). Whatever the case may be, we need to take into consideration that over 3 million Americans are disfluent due to developmental stuttering according to the Stuttering Foundation of America (2015). By contrast, the number of people who may be currently affected by amyotrophic lateral sclerosis (ALS) is 30,000 (The ALS Association, 2015). The ice bucket challenge was successful in raising awareness for this disease that has no cure. Unfortunately, we have not found a definite cure for stuttering either, and there are one hundred times more people who stutter than people currently affected by ALS. Although there is no cure, current evidence-based therapy techniques are often utilized to alleviate stuttering events. However, relapse after treatment is common, and there is a growing need to research more possible treatments that will not only decrease the severity of an individual's stutter, but also increase their perceived quality of life in relation to how their emotions, mental and physical functions, well-being, and overall satisfaction in life are affected (Patrick & Erickson, 2013; as cited in Beilby, Byrnes, Meagher, & Yaruss, 2013).

Recent studies shed light on precisely how stuttering impacts quality of life. Klompas and Ross (2004) conducted a lengthy interview with 16 individuals whose average age was ~29 years (range: 20 to 59 years)(Klompas & Ross, 2004). Each person was asked a variety of questions about education (academic performance, oral presentations, and relationships with teachers and classmates), employment (ability to obtain work, performance at work, relationships with supervisors, chances of promotion), and speech therapy (previous therapy, impact of speech therapy on quality of life, coping strategies for stuttering) (Klompas & Ross, 2004). Additionally, each person was asked to provide personal information regarding family and marital life (relationships with parents, siblings, spouses, partners, and decisions to have children), social life (making new friends, fear of talking, being teased, listeners' understanding of stuttering, cultural beliefs of cause of stuttering), and identify, beliefs, and emotional aspects (personal definitions of stuttering, beliefs regarding causes of stuttering, effects of stuttering on self-image, emotions evoked by stuttering, finding a cure for their stuttering, and acceptance of their stuttering) (Klompas & Ross, 2004). Although experiences and feelings varied from person to person, the study found that stuttering had a negative effect on self-esteem, self-image, and self-identity, and that stuttering brought about strong negative emotions in every participant (Klompas & Ross, 2004). Similarly, a study completed by Bray, Kehle, Lawless, & Theodore (2003) concluded that adolescents who stutter differ from peers of the same age when considering their self-efficacy for speaking, which may be due to the difficulty of maintaining fluency as well as the likelihood of feelings of embarrassment after a disfluent episode.

A systematic review of published research about behavioral, cognitive, and similar treatments for developmental stuttering (Bothe, Davidow, Bramlett, & Ingham, 2006) concluded that, for adults who stutter, the most successful treatment approaches consist of prolonged-speech-type methods encompassed within an extensive treatment plan. They determined that a most effective plan of treatment would typically consist of an initial intensive approach, followed by a focus on practicing in front of groups, carryover tasks, self-evaluation, self-management, and naturalness of speech (Bothe et al., 2006). According to Prins & Ingham (2009), two main behavioral treatment approaches have been proven to be evidence-based and efficacious in adolescents and adults. They include fluency shaping (FS) and stuttering modification (SM). The general purpose of fluency shaping is to reduce or eliminate moments of stuttering, thereby creating an environment which enhances the production of fluent speech (Prins & Ingham, 2009). Fluent speech can be induced by the speaker's usage of a very slow rate, elongation of vowels, and/or stretching out the interval between speech segments (Yairi & Seery, 2015). According to Blomgren (2013), fluency shaping aims to ultimately change the speech pattern of the speaker by emphasizing slow movements, lessened articulatory pressures, and initiation of vocal fold vibration in a gradual, controlled manner, in attempts to alleviate or eliminate some or all stuttering events. The goal for stuttering modification is to influence PWS in such a way that even when speaking disfluently, they will be desensitized to producing abnormal reactions and will not be putting forth unnecessary effort while speaking (Prins & Ingham, 2009). Stuttering modification techniques are cognitively based and accomplished when the speaker utilizes self-monitoring and redirection of speech movements just after, during, or when a moment of stuttering is expected to arise (Yairi & Seery, 2015). According to Webster (as cited in Blomgren, 2013), treatment to address stuttering has been found to be most effective when delivered in an intensive manner, however, these rigorous stuttering treatments are considered to be very time consuming. Many intensive programs consist of 60 to 100 hours of treatment over the course of just two to three weeks (Blomgren, Roy, Callister, & Merrill, 2005; Blomgren, 2010; Blomgren, 2013; Boberg, 1994). The University of Utah Intensive Stuttering Clinic (UUISC) targets three core and four supplementary techniques, as well as five stuttering management techniques throughout therapy for participants to focus on while speaking, resulting in a heavy dosage of self-monitoring which can be exhausting to consistently attend to (Blomgren, 2013). All participants are instructed on how to achieve a stretched syllable target in order to increase awareness of speech, how to achieve a gentle phonatory onset target in order to initiate vocal fold vibration in a specifically composed manner, and how to target reduced articulatory pressure in order to promote smooth transitions between speech sounds within running speech (Blomgren, 2013). Depending upon individual circumstances, participants may be instructed on one or more supplementary techniques including the use of full breath, smooth articulatory change, continuous phonation, and/or full articulatory movement (Blomgren, 2013). The five stuttering management techniques that all participants focus on include maintaining eye contact, openly acknowledging one’s stutter with listeners, pseudo stuttering, terminating a stuttering moment on purpose, and cancelling a stuttered word by attempting the word again fluently (Blomgren, 2013). While enrolled in an intensive stuttering program, it is common for PWS to have individual and/or group therapy within a clinical setting, eventually transferring the treatment session to public settings for continued practice of newly acquired techniques (Blomgren et al., 2005). Participants may be assigned speaking tasks in order to practice these techniques, such as conducting surveys or participating in telephone conversations, and other speaking tasks (Blomgren et al., 2005; Boberg, 1994). However, few studies can actually justify their selection(s) of particular within-clinic and/or beyond-clinic speaking tasks according to Ingham, Ingham, and Bothe (2012), which may result in a PWS's opinion of a treatment approach to be personally irrelevant. This may result in a lack of generalization of clinical skills into the person's daily life.

Although stuttering modification, fluency shaping, and other fluency therapy techniques have been proven to lessen, eliminate, or modify stuttering, the National Stuttering Association reported in a 2009 survey that 84% of the 717 adult and teen participants who stutter experienced relapse after improving their fluency in therapy whether treatment was received in a school-based setting (grade school/middle school/high school), a university speech clinic, a private speech therapist, or in an intensive or live-in program. Various theories have been postulated for why relapse occurs: the speaker has let fear and avoidance overcome them, leading to stuttering more often or not being able to deliberately stutter when wanting to have sense of control; the speaker has stopped using fluency control techniques they have previously learned; the level of attention and concentration required to produce fluent speech is mentally taxing; the demands of fluency from environments outside of the clinic and the lack of support from a clinician in those environments can have an effect on a speaker; and the speaker may have set an expectation of spontaneous fluency that they do not yet have the ability to uphold, which may undermine their confidence, increasing fear and panic (Spillers, 2011). Genetics may have a major role in a speaker's reactions to a moment of stuttering (Spillers, 2011). Maintaining fluency and avoiding relapse may be largely dependent on the speaker assuming the responsibilities of a fluent lifestyle (Goldberg, 1997). The need to research potential successful interventions for stuttering is warranted considering the effects stuttering can have on an individual and the rate at which relapse is likely to occur. Further research on neural components that may be altered or enhanced during treatment for stuttering as well as post-treatment is warranted in the quest for determining a most effective intervention method for the alleviation or elimination of stuttering events.

Below, I will first review current theories and results from neuroimaging studies conducted on both PWS and in people who do not stutter (PWNS). The information gathered will give insight into what areas of the brain are likely to be activated and/or deactivated in either or both groups of people, whether they are speaking fluently or disfluently. Then, I will examine research surrounding plasticity and compensation shown to occur within the neurology of PWS. Information gathered from these studies will provide insight into how the brain may have the ability to change, to form new neural connections, or to strengthen specific areas when activated regularly. Lastly, I will discuss the research conducted by Bruce Crosson and colleagues in regards to right hemisphere activation and intention-focused training, and how the intention-focused training may be successful when used as a treatment for stuttering.

Current Neuroimaging Studies

Neuroimaging studies determining brain activity during fluent speech in both PWS and in PWNS and stuttered speech in PWS as well as the “state” and “trait” of stuttering have been analyzed by many researchers. Ingham, Cykowski, Ingham, & Fox (2012) came to the conclusion that numerous brain imaging studies have inferred that persistent developmental stuttering is correlated with abnormalities in neuroanatomy and neurophysiology (as cited in Ingham, Grafton, Bothe, & Ingham, 2012).

An experiment conducted by Lu et al. (2009) investigated connection patterns in the brain between ten PWS and nine PWNS in order to determine the role of large-scale neural interactions that occur in PWS, and found that difficulties in planning, execution, and self-monitoring of speech motor sequencing during word production may be attributed to large-scale dysfunctional neural interactions in PWS. Results showed that when compared to activations found in PWNS, PWS did not show any activation in several of the supposed left hemisphere speech areas including Broca’s area, but instead showed bilateral or right hemisphere activations (Lu et al., 2009). Additional findings indicated that PWS did not show specific neural networks related to various cognitive processes of word production (Lu et al., 2009). This may be due to dysfunction of large-scale neural interactions on that a causal location in the brain for stuttering moments may not be able to be pinpointed as dysfunctions are likely to occur in a variety of areas in the brain, perhaps in both hemispheres (Lu et al., 2009).

A meta-analysis conducted by Brown, Ingham, Ingham, Laird, & Fox (2005) sought to examine stuttered productions in PWS and fluent productions in PWNS and found that PWS showed activated brain areas during moments of stuttering similar to activated brain areas during fluent speech with the exception of three findings: 1) overactivation in motor areas including primary motor cortex, supplementary motor area (SMA), cingulate motor area, and cerebellar vermis during stuttering; 2) atypical activation and lateralization of the frontal operculum, Rolandic operculum, and anterior insula to the right hemisphere in PWS; and 3) undetected auditory activations that arose from a speaker hearing their own speech (Brown et al., 2005). Findings indicated that although activations in the brain during stuttered speech were found in the same definitive areas important for speech production in general, there was an increased number of brain activations occurring in a broader range of cortical area in PWS when compared to PWNS when they were performing the same tasks, and that initiation of the motor program might have been dysfunctional (Brown et al., 2005).

Belyk, Kraft, & Brown (2015) conducted a meta-analysis as an update to Brown et al.'s (2005) meta-analysis, which included a suggestion for differences between "state" and "trait" stuttering. Trait stuttering refers to the person who stutters and is not stuttering at the moment of brain activation analysis (Belyk et al., 2015). State stuttering refers to the actual stuttering moment and the brain activations occurring during the event (Belyk et al., 2015). Analysis of trait stuttering was conducted with a between-groups comparison of PWNS and PWS who were experiencing fluent speech at a specific moment, while analysis of state stuttering was administered as a within-groups comparison of fluent speech moments and stuttered speech moments in PWS (Belyk et al., 2015). Findings regarding state stuttering included such things as atypical overactivation of right hemisphere larynx and lip motor cortex in the homologous location of left hemisphere underactivation found in trait stuttering, overactivation of the

SMA, and underactivation of the right primary auditory cortex (Belyk et al., 2015). Findings regarding trait stuttering included a shift in lateralization to the right hemisphere for activation of language and speech areas, overactivation of the right homologue of Broca's area in the frontal operculum, overactivation of lip motor cortex in the right hemisphere but underactivation of larynx motor cortex in the left hemisphere, overactivation of the pre-SMA, and underactivation (found to be weaker than state stuttering) in the left primary auditory cortex (Belyk et al., 2015).

Elaborating on Brown et al.'s findings (2005), Belyk and colleagues found that overactivations of the right inferior frontal gyrus (IFG)/frontal operculum occurred only during trait stuttering (fluent speech), underactivation of the auditory cortex would be detected in both trait and state stuttering, and while overactivation of the cerebellar vermis was noted during state stuttering, underactivation was observed during trait stuttering, which may spark additional research interest in how the cerebellum is involved in PWS (Belyk et al., 2015). A study of ten PWS and ten PWNS found that stutter-rate correlates were lateralized to the right cerebral and the left cerebellar hemispheres, and like Belyk et al. (2015), concluded that the cerebellum may have a specific role in the fluent speech of PWS (Fox et al., 2000).

With regard to fluent speech (trait stuttering), it is important to note that the right hemisphere homologue to Broca's area, as well as other right-hemisphere premotor areas, were more active in PWS than in PWNS during fluent speech (Belyk et al., 2015). Also, "trait stuttering was associated with an increased likelihood of activation almost exclusively in the right hemisphere and a decreased likelihood of activation almost exclusively in the left hemisphere" (Belyk et al., 2015, p. 278). This may indicate that when fluent speech occurs in PWS, right hemisphere activations are increased.

Plasticity and Compensation

Findings from neuroimaging research have concluded that persistent developmental stuttering (PDS) may be due to abnormalities in the white matter of the speech areas of the left hemisphere which may be accompanied by overactivations in the right hemisphere (Neumann et al., 2004). According to Preibisch et al. (2003) overactivation in the right hemisphere in PWS may be indicative of a compensatory mechanism and can be observed with functional neuroimaging as reviewed in the previous section. When structural brain abnormalities in the left hemisphere are found with functional imaging in PWS, we may be able to attribute the resulting right-lateralized brain activation to developmental plasticity (Fox, 2003). Two functional magnetic resonance imaging (fMRI) experiments were conducted with the aim of assigning cortical regions that act as compensatory mechanisms and to address right hemisphere overactivation in PWS (Preibisch et al., 2003). In order for the neural activity in cortical regions to be considered anomalous, it had to be consistent across the PWS subjects and undetectable in control subjects as the two groups performed the same tasks (Preibisch et al., 2003). A region in the right frontal operculum (RFO) that was activated in 14 out of the 16 PWS subjects during fluent reading was not found to exhibit detectable activity (Preibisch et al., 2003). Furthermore, stuttering was not present during reading which led researchers to come to the conclusion that RFO overactivation might be indicative of a compensatory strategy used to achieve fluent speech (Preibisch et al., 2003). Results showed overactivation during fluent reading in PWS, as well as in silent semantic decision making in PWS, that was not observed in the control group; this led the researchers to conclude that the RFO is not only utilized as a compensatory mechanism during the final stages of speech production, but can be considered a structure of nonspecific compensation ability in the homologous contralateral region of the brain (Preibisch et al., 2003). Similarly, a study focused on examining neural correlates of language recovery in four patients who presented with left frontal lesions and nonfluent aphasia found that compensation/recovery in a homologous contralateral region had occurred (Rosen et al., 2000). The notion that the right brain is recruited as a compensatory mechanism in both PWS and people with nonfluent aphasia, as eluded to in the aforementioned studies, gives way to justification of research of new treatment possibilities for PWS by considering the usage of intervention strategies implemented in people who experience nonfluent aphasia.

New Intervention Considerations

Bruce Crosson and colleagues have been researching the effects of intention- and attention-focused treatment approaches in subjects experiencing nonfluent aphasia with hopes that, for intention-focused treatment, right frontal activation during word retrieval would intensify, and for attention-focused treatment, the amplification of right posterior perisylvian participation (Crosson et al., 2007). Persons experiencing nonfluent aphasia may struggle to initiate and maintain an adequate flow of spoken output with scattered hesitations, frequent pauses, and short phrases that lack content (Crosson et al., 2007). Intention is defined as the act of designating one action among many to be implemented, as well as the initiation of the chosen action, which can help to promote word selection, and the initiation of speech (Crosson et al., 2005). Attention is referred to as the ability to elect one source of information from an array of competing sources for continued processing (Crosson et al., 2005). The intention-focused treatment consists of a series of picture-naming trials with the addition of a complex hand movement, which aims to enrich right frontal activation during retrieval of words (Crosson et al., 2007). The attention-focused treatment is completed by placing the pictures in the subject's left visual field, and having the subject name the picture, which is proposed to improve right posterior perisylvian activation while word retrieval is occurring (Crosson et al., 2007). The premise for utilizing a complex hand movement while attempting to produce words stems from Picard and Strick's (1996) analyses of imaging studies which concluded that the pre-SMA is activated during both complex hand movements and in word generation, increasing word generation efficiency by strengthening the right pre-SMA with a complex left-hand movement.

Crosson and colleagues (2005) investigated the intention-focused and attention-focused treatment of two subjects who presented with residual nonfluent aphasia after an ischemic stroke. Both subjects were given a pre-treatment fMRI and post-treatment fMRI. The first subject's pre-treatment fMRI revealed most activity occurring in the left vs. right pre-supplementary motor area (pre-SMA) and an approximately equal amount of activity in the left and right lateral frontal lobes (Crosson et al., 2005). During post-treatment images, however, the results showed activity more than doubling in the right lateral frontal lobe while activity in the left lateral frontal lobe decreased minimally (Crosson et al., 2005). In addition, activity in both the left and right pre-SMAs increased; however the increase in the right pre-SMA surpassed the gains made in the left pre-SMA (Crosson et al., 2005). The second subject's pre-treatment fMRI revealed an already occurring shift of intention and language production structures to the right hemisphere including pre-SMA activity almost completely shifted to the right hemisphere and lateral frontal activity almost completely lateralized to the right without a considerable amount of activity in the left pre-SMA or the left lateral frontal cortex (Crosson et al., 2005). Post-treatment fMRI showed a shift occurring to the left-hemisphere language area, which was paired with a decrease in right frontal activity, although the lateral frontal activity continued to present as right-lateralized (Crosson et al., 2005). It is important to note that in people presenting with small lesions and a good prognosis for recovery, the left hemisphere typically activates and initiates recovery, while people presenting with larger lesions and a poor prognosis for recovery, the activity noticed in the right hemisphere exceeds activity in the left hemisphere, suggesting that if the left hemisphere structures are not spared adequately after a stroke, the right hemisphere may compensate and initiate recovery (Crosson, 2008). Findings from this novel treatment for aphasia indicate variations in neuroplasticity dependent upon the lesion sites and severity of word-finding impairment, the potential for the right frontal cortex to assume rehabilitation responsibilities when the left frontal cortex is too damaged to support language production, and the probable success of shifting language production to the right hemisphere via intention-focused treatment (Crosson et al., 2005).

Similarly, Crosson and colleagues (2007) examined the results from the intention-focused and attention-focused treatments of 34 subjects who presented with moderate-severe to profound deterioration of word-finding ability after experiencing either an ischemic or hemorrhagic left hemisphere stroke. 23 of the subjects were diagnosed with chronic nonfluent aphasia with moderate-severe word-finding impairment, and the remaining 11 subjects were diagnosed with chronic nonfluent aphasia with profound word-finding impairment. Results from this study indicated that 89% of qualified subjects with moderate-severe word-finding impairment had substantial gains in naming performance during the intention treatment, and 85% of the qualified subjects showed improvement in untrained items relative to baseline measures (Crosson et al., 2007). Additionally, 55% of qualified subjects with profound word-finding impairment demonstrated improvement during the intention treatment, and 55% of the qualified subjects showed substantial improvement in untrained items relative to baseline measures (Crosson et al., 2007). However, without having collected any functional neuroimaging data during this study, Crosson and colleagues could not conclude that the successful increase in language production ability was due to right frontal lateralization of language production as a result of using a complex hand movement.

In another study, Crosson and colleagues (2009) once again tested the prediction that lateralization to the right frontal lobe could be initiated by intention-focused treatment. For this study, pre- and post-treatment fMRIs were conducted, 6 weeks apart, on five subjects presenting with nonfluent aphasia during category-member generating tasks, and comparisons were made to five neurologically normal age-matched controls involved in another study (Crosson et al., 2009). From the pre-treatment fMRI data, it was shown that the subjects with aphasia did not present with a complete shift to the right frontal lobe for word production, and the control subject comparisons also did not present with a shift in frontal lateralization to the right hemisphere (Crosson et al., 2009). Results from this study indicate that four out of the five subjects with aphasia improved with intention-focused training and presented with a shift to the right lateral frontal lobe for category-member generation of words, and three of the four subjects who improved with intention-focused training demonstrated a complete shift of lateral frontal activity to the right hemisphere (Crosson et al., 2009). Lateralization was found to be considerably higher for subjects with aphasia than control subject comparisons, and no control subjects demonstrated complete lateralization to the right hemisphere (Crosson et al., 2009).

Benjamin and colleagues (2014) introduced the inclusion of a control group (CT) of people with nonfluent aphasia to receive the same treatment as the intention-focused group (IT), except the CT group would not use the complex hand movement during treatment, in order to see if a shift in lateral frontal activity was in fact due to the complex left-hand movements made during intention-focused treatment. A total of 14 subjects were included in the study, who were randomly assigned to two groups, with both treatments involving picture-naming and category-member generation, while the IT group also used the complex left-hand movement (Benjamin et al., 2014). The results of the study indicated that there was a shift in lateral frontal activity from the left to the right hemisphere for the IT group from pre- to immediately following post-treatment and at a 3-month follow-up measure, while no shift was noted for the CT group (Benjamin et al., 2014). This suggests that the inclusion of the left-hand movement in the treatment protocol, and not the word-finding treatment itself, could be the reason why the shift in lateralization occurred for the IT group (Benjamin et al., 2014). At the 3-month follow-up measure, a shift in the medial frontal laterality from left to right was noted in the IT group that was not noticed immediately post-treatment and not noticed in the CT group at any measurement (Benjamin et al., 2014). Generally, the results from this study conclude that cortical manipulations can occur following the execution of specific behavioral acts (Benjamin et al., 2014).

Summary/Research Question

Although evidence-based treatment options are the basis for fluency therapy today, a treatment option that eradicates disfluency completely has yet to be proven. Taking into consideration the current neuroimaging studies, meta-analyses, and evidence of neural plasticity and compensation in PWS, further research is warranted in the areas of treatment approaches that are aimed at strengthening specific parts of the brain that are associated with fluent speech in PWS. Neural imaging has the potential to be a proponent for advancement in fluency enhancing treatment techniques. The intention-focused treatment, developed by Crosson and colleagues, aims to strengthen activity in the right hemisphere of people who have experienced nonfluent aphasia after a stroke. Crosson's treatment approach, when compared to traditional intensive stuttering intervention, does not take as long to complete, involves low self-monitoring during treatment, and is easy to complete.

The aim of this thesis study was to determine if a pilot intervention for fluency, adapted from the intention-focused intervention including a left-handed movement during training (Crosson et al., 2007), would change stuttering frequency in familiar and structured speech tasks. The rationale for choosing familiar and structured speech tasks during the intention-focused treatment comes from the findings that functional improvements have been documented in treatments that incorporate personally relevant speaking tasks and/or situations, selected by the person who stutters (Ingham et al., 2012). Personally relevant speaking tasks may include, but are not limited to saying one's name aloud, public speaking, and casual conversations about familiar concepts, daily news, and customary events or situations occurring in the home or on the job. Although these types of tasks are easier to execute than unfamiliar or unstructured tasks, it is important to note that stuttering events occur whether a task is easy or not. Familiar and structured tasks are more commonplace in daily life, and it is interesting to examine the frequency of stutter events in these types of tasks following the intention-focused treatment, especially if compared to unfamiliar and unstructured tasks. Based on results from Crosson et al.'s (2007) study, I would expect a decrease in stuttering symptoms and behaviors following the conclusion of the intention-focused treatment.

METHODS

Participants

Two female participants with developmental stuttering present since childhood were recruited from a list of people who had reached out to the Department of Communication Sciences and Disorders at the University of South Florida to inquire about treatment options and research opportunities for people who stutter. Participant 1 was bilingual, speaking English and Spanish, and left-handed. Her treatment history includes public school based speech therapy for stuttering, which she attended from kindergarten through twelfth grade. She attended college at the undergraduate level, taking a full schedule of courses throughout the study. Due to demands placed on Participant 1 from juggling academics and personal life, she was often feeling stressed and overwhelmed, which might have had an effect on her frequency and intensity of stuttering. She experienced mild anxiety and was very sensitive to reactions from listeners as she spoke. Participant 2 was monolingual (English), and right-handed. Her treatment history includes speech therapy that focused on articulation, from kindergarten through fifth grade. She has had no prior formal treatment for stuttering. She attended college as a full-time undergraduate student during the study. Throughout the study, Participant 2 frequently mentioned lack of sleep, and mild social anxiety that might have had an effect on her stuttering.

Stimuli

Throughout each week of intervention, and during the maintenance period, a library of 795 black and white line drawings was used, including 520 common objects and 275 transitive and intransitive actions from the International Picture Naming Project (IPNP; Szekely et al., 2005). Each picture measured 300 x 300 pixels, and was centered in the middle of the computer screen for presentation to each participant. A randomized selection from the entire library of objects and actions was used during each session.

Additional stimuli included a 1000 Hz tone generated from Eprime software, Version 1.1 (Psychology Software Tools, Sharpsburg, PA) utilized during the first week, which accompanied a size 60, Arial font asterisk, referred to as a "star" throughout the study. The participants completed intervention weekly, using the Eprime software on a computer separate from the computer used during treatment. This computer was positioned outside of the soundproof booth and was accessed only by the investigator.

Treatment (Independent Variable)

The treatment methods used throughout the study were adapted from the work completed by Crosson and colleagues (2007). Crosson et al. (2007) conducted two separate treatments, intention-focused and attention-focused, each consisting of three phases for a total of six weeks per treatment. This study concentrated solely on the intention-focused training. Each participant completed three weeks of the right-brain training treatment protocol. Treatment included the use of complex left-handed movements to initiate picture-naming trials. The purpose of using the complex left-handed movements was to stimulate the pre-SMA region in the right hemisphere of the brain, which is proposed to be involved during word generation (Crosson et al., 2007), to encourage activation of the right hemisphere prior to speech production, in order to promote lateralization of motor planning and execution to the right hemisphere.

In the Crosson et al. (2007) study, subjects were administered one 45-minute session per day, five days per week. Each treatment phase was completed over the course of two weeks. If subjects were unable to attend each of the five days, they were offered a treatment plan of two sessions per day, with a 30-minute break between treatments. In the intention-focused study for PWS, each phase lasted one week and both participants received two 30-minute treatments per day, with a 30-minute break between treatments. Participant 1 received ten treatment sessions per week for a total of 15 hours of intervention, and Participant 2 received six treatment sessions per week, for a total of nine hours of intervention, due to her inability to participate more than three days per week. A summary of the treatment schedule and measures obtained is shown in Table 1.

Table 1. Participant Treatment Schedule and Obtained Measures

	Baseline	**Intention Training**			**Independent Maintenance**			**Follow-Up**
Schedule	Pre-Tx No training	Week 1 (Phase 1)	Week 2 (Phase 2)	Week 3 (Phase 3)	Weeks 4 & 5	Weeks 6 & 7	Weeks 8 & 9	Week 10 No training
Measure Obtained	Baseline speech samples: six retell, six reading	Speech samples: two retell, two reading	Speech samples: two retell, two reading	Post-treatment speech samples: four retell, four reading	No measures	No measures	No measures	Follow-Up speech samples: four retell, four reading

Measures (Dependent Variable)

Each participant's fluency was measured in four tasks including familiar reading, structured retell, unfamiliar reading, and unstructured retell. This thesis concentrated on the results from the familiar reading task and the structured retell task.

The familiar reading transcript used in the present study was *The Rainbow Passage* (Fairbanks, 1960), a common reading passage utilized for speech and fluency evaluation due to the fact that it contains almost every phoneme in the English language as well as the syllabic /m/ in 'prism' and the syllabic /l/ in Aristotle.

For the structured retell task, participants watched approximately ten minutes of the film, "City Lights" (Chaplin, 1933), before retelling what had happened in the story. Although the film provided no dialogue, the viewer could easily follow along with the characters, the setting, and the storyline in order to formulate a concrete idea about what may be going on in the film, what led up to certain points in the film, and what may happen next. Film clips were shown to the participant in temporal order, so the participant could follow along with the film as intended while she described the film.

The speech samples collected during each task were obtained at baseline (pre-treatment), at the end of each weekly treatment phase, at post-treatment, and during follow-up measures, which were obtained seven weeks post-treatment. Participants were videotaped using a hand-held video recorder during each reading and retell task. Each speech sample was transcribed and coded by the investigator offline at a later date. For the reading task, the middle 100 words was transcribed and coded for symptoms and behaviors in relation to stutter events. For the structured retell task, a 100-word sample was taken 30 seconds into each monologue. Rarely, the investigator was required to prompt the participant for a more substantial speech sample by asking a question for further elicitation. If this did occur, the investigator would take the sample starting from 30 seconds from the time of interruption.

Once transcribed, samples were coded for stuttering symptoms and behaviors based on the *Lidcombe Behavioral Data Language of Stuttering* (LBDL; Teesson, Packman, & Onslow, 2003). The classification of these symptoms and behaviors can be broken down into primary symptoms involving stuttering frequency and duration of stutter, and secondary behaviors including escape and avoidance behaviors, used during moments of stuttering in order to get through the stuttering event to continue speaking (Blomgren et al., 2005). The primary symptoms found in Table 2 include repetitions (syllable repetitions, incomplete syllable repetitions, and multisyllable unit repetitions), audible sound prolongations (fixed posture with audible airflow), and silent blocks (fixed posture without audible airflow). The secondary behaviors found in Table 2 include verbal behaviors, or "accessory sounds," including but not limited to starter/filler words ("um," "well," "like"), moments of giggling, substitution of words (saying "laptop" instead of "iPad" because a stutter would occur if the word "iPad" was attempted, distortions of words ("sippery" instead of "slippery"), and retrials ("I went to-- I went to-- I went to school"). Another type of secondary behavior found in Table 2 is nonverbal behaviors, which can include gross motor movements of the head, arms, hands, legs, feet, and other larger scale movements, and fine motor movements including eye movements, eyebrow movements, nostril flares, and other smaller scale movements. The occurrence of multiple stuttering instances, when one or more symptoms or behaviors were used in conjunction with one another are also indicated in Table 2 (transcribed as “mixed”).

Interrater reliability was conducted by comparing the codes of the investigator with those of another trained therapist. The investigator and the trained therapist met numerous times in order to train for coding. Transcripts were compared to one another and discrepancies were discussed and resolved throughout the transcription and coding processes. One sample from each speaker and task type, for a total of 14 percent of the samples, was scored. Reliability was found to be an 89 percent agreement (range: 83 to 94 percent).

The investigator completed analysis of each coded transcription. Results obtained from the coded transcriptions were organized into total disfluency count, total number of primary stuttering symptoms, total number of secondary behaviors, and percentage of syllables affected by primary stuttering symptoms and/or secondary behaviors. Dependent on the target measurement during analysis, the percentage of syllables affected was calculated by dividing the number of syllables uttered occurring with simultaneous primary symptom(s) and/or secondary behavior(s) of stuttering by the total number of syllables in the sample. This differs from the total disfluency count in that multiple disfluencies may occur on one syllable. The percentage of syllables only takes into consideration the actual number of syllables affected, excluding the volume of symptoms and behaviors coinciding with each syllable.

Table 2. Stuttering Symptoms/Behaviors Coding System

Descriptor of Disfluency	Examples of Corresponding Symptom/Behavior	Code
Primary Symptoms with Acronyms		
Syllable Repetition (SR)	“where...where...where’s the ball?”	“where...where...where’s the ball”
Incomplete Syllable Repetition (ISR)	“I went to S...S...Sydney…”	“I went to S ...S...Sydney
Multisyllable Unit Repetition (MUR)	“it’s a...it’s a...it’s a great…” “what a great oppor...oppor...tunity” “swimming...swimming”	multisyllable unit repeated
Fixed Posture with Audible Airflow (FWA)	“mmmmmy one” “fffffishy gone!”	* (*my/ *fishy)
Fixed Posture Without Audible Airflow (FWOA)	“I…..(no sound) bought…” (Sounds kind of forced out)	__ “I __ bought”
Secondary Behaviors		
Superfluous verbal behaviors (things you can hear)	“I went - oh well - ah - oh well - I - well I went over…” Grunting Um/Yeah/Like	+behavior (+um/+yeah)
Superfluous nonverbal behaviors	Tics, grimacing, secondary behaviors	(@whatever the trick is)
DURING READING PASSAGE: Substitution of word	Word expected: may Word said: will	STRIKE THROUGH may (will)
Combination of Symptoms and/or Behaviors		
Mixed	Mix of any of the above stuttering symptoms/behaviors - indicated with which two or more symptoms/behaviors were used	Highlight

Procedures

1. Baseline (3 Sessions)

Speech samples for pre-treatment baseline measurements were taken on three separate days before participants began the intention-focused treatment. Samples from Participant 1 were obtained on Monday, Wednesday, and Friday, beginning two weeks prior to initiation of the first week of training. Samples from Participant 2 were taken on Monday, Tuesday, and Wednesday, during the week prior to initiation of the first week of training. Throughout the intention-focused training, weekly measures were taken from Participant 1 on Fridays and from Participant 2 on Wednesdays, immediately following the final treatment session of the week.

Before collecting each speech sample, participants were given detailed instructions they should follow during the sample collection. Prior to the familiar reading (Rainbow Passage), participants were handed a transcript to be read aloud upon the cue to begin. They were asked to examine the passage and identify any unfamiliar words that had the potential to pose difficulty when producing the word, in order to ensure that an inability to decode a word was not a factor in their fluency. They were asked to read aloud each transcript as they would normally, as natural as possible, given specific instructions to not use any therapy methods previously learned. Prior to the oral retell tasks, each participant watched a predetermined length of the accompanying film on a laptop computer positioned directly in front of them. Prior to collecting the speech sample following the structured retell (Charlie Chaplin), participants were instructed to speak for approximately five minutes about what they had just watched, how it related to the previous part, and what they think may happen as the film continues. Participants were encouraged to provide as much detail as possible. If the participants did not speak long enough to collect an adequate sample, the investigator would attempt to elicit an additional speech sample by using simple, open-ended questions in order to promote continuation of the description. Participants were reminded to speak naturally and encouraged to not use any previously learned therapy methods during speech production.

2. Treatment/Training (3 Weeks)

Treatment procedures for the training study were conducted in a dimly lit, soundproof booth, where the participants faced a 23-inch computer monitor placed at eye level for the duration of each 30-minute trial. Throughout each trial, the investigator sat in a chair, to the left and slightly behind the participant's visual field. A serial response box (Psychology Software Tools, Sharpsburg, PA) with five buttons numerically labeled was housed inside an 11.5-inch by 9-inch black, cardboard box with a 6-inch-long by 3-inch-high blue plastic handle of 1-inch diameter glued to the lid of the box. The lid of the cardboard box was constructed to provide a medium amount of resistance upon removal from the box. The box sat on a table between the computer monitor and the participant, to the left of the participant. Prior to the initiation of each trial, the participant was given specific instructions by the investigator regarding procedures to follow throughout the duration of each task during each week. Participants were instructed to use their left hand only when reaching for the lid of the box, for pressing the response buttons, and for making non-meaningful circular movements, when applicable. Participants were additionally instructed to provide the single best name or word that they could generate in order to describe the object or action depicted onscreen, for the naming portion of each task.

During Week 1, the participant and investigator sat in a soundproof booth with the box placed slightly in front and to the participant's left. The investigator initiated the treatment session by pressing the spacebar on the computer outside of the soundproof booth before joining the participant in the booth. A size 60-font single asterisk (star) appeared on the screen and after five seconds, a 1000-Hz tone would sound. When the participant heard the tone, they would open the box, place the lid off to the side, reach with their left hand into the box, and press any button within the box. Every movement was to be completed with the participant's left hand, with their right hand resting still throughout the session. After pressing the button, the star would disappear and a black and white line drawing would immediately appear on the monitor. The participant would then name the picture. If the participant named the picture fluently, the investigator would place the lid back onto the box and click the mouse to advance to the next item. A fluent response was defined as a word production made without evidence of stuttering symptoms or behaviors. A disfluent response was defined as a word production that included any symptom or behavior of stuttering. Once the investigator clicked the computer mouse, a new star would immediately appear on the monitor. If the participant had a moment of disfluency while naming the picture, the investigator would model a non-meaningful circular left-hand movement while saying the word. The participant would then repeat the correct picture name while making the left-handed movement three times.

During Week 2, the participant and investigator were seated the same as in Week 1 and the box and computer screen were in the same location. The investigator initiated the first trial by pressing the spacebar on the computer outside of the soundproof booth prior to joining the participant inside the booth. During Week 2, the tone that accompanied the star was eliminated and there a two second delay added, occurring between the time when the participant pressed a button within the box and the line drawing appearing on the screen. When the participant saw the star, they would open the box, place the lid to the side, reach into the box, and press any button within the box, all while moving their left hand only. After pressing a button, the star would disappear, and a black and white line drawing would appear on the monitor following a two second delay. The participant would immediately name the picture. If the participant named the picture fluently, the investigator would reset the box and initiate the next trial. If the participant were disfluent while naming the picture, the investigator would model the same non-meaningful circular left-hand movement while saying the word. The participant would repeat the acceptable picture name while forming the left-handed movement three times. Following a fluent naming of the picture, the investigator would then begin the next trial.

During Week 3, the box and the initial tone were removed. The investigator initiated the first trial by pressing the spacebar on the computer outside of the soundproof booth before joining the participant. When the star appeared, the participant would perform the same non-meaningful circular left-hand gesture, as mentioned above, three times. Once the participant had completed the left-handed movement, the investigator would click the button on the serial response box, bringing a black and white line drawing onto the screen after a two-second delay. The participant would name the pictured object or action shown. If the participant fluently named the picture, the investigator would initiate the next trial by clicking the mouse and bringing a star onto the screen. If the participant were disfluent while naming the picture, the investigator would model the same non-meaningful circular left-hand movement while saying the word. The participant would repeat the acceptable picture name while making the left-handed movement three times. Following fluent naming of the picture, the investigator would begin the next trial.

Throughout each week of treatment, Participant 1 named an average of 147 words per half-hour session and Participant 2 named an average of 137 words per half-hour session.

3. Post-Treatment (1 Session)

Post-treatment measures were recorded on the closing day of Week 3, immediately following the cessation treatment. During post-treatment measurements, a total of eight speech samples were taken per participant. In addition to the four measures per speech task was a supplementary set of four additional measures. The supplementary speech samples consisted of the four tasks previously mentioned, including the addition of a left-handed circular movement based on Week 3 protocol implemented during the first word of each phrase while speaking. For each of the retell samples, an additional ten to fifteen minutes of the film was provided for additional speaking material in order to ensure sufficient content for the tasks.

4. Maintenance (6 Weeks)

Upon conclusion of the three-week treatment period, participants were given instructions, materials, and a log for a maintenance program extending over the course of six weeks, to be completed before follow-up measures were obtained during the seventh week post-treatment. Maintenance materials included a series of 18 PowerPoint presentations, labeled Day 1 through Day 18, each consisting of 100 randomly selected objects and actions comprised from the IPNP (Szekely et al., 2005). At the beginning of each week, participants were provided with the PowerPoints they would use for the week, via email. Presentation content was randomly organized, ensuring variability and nonconformity among presentations. Participants were instructed to spend five minutes on each daily session, as measured with a timer. The maintenance program was split up into three phases. Phase 1 was to be completed during weeks 1 and 2 post-treatment and consisted of the participant completing five sessions throughout each week on five separate days. Phase 2 was to be completed during weeks 3 and 4 post-treatment, and consisted of the participant completing three sessions throughout each week on three separate days. Phase 3 was to be completed during weeks 5 and 6 post-treatment, and consisted of the participant completing one session throughout each week. Participants were instructed to set a timer for five minutes and open the corresponding day's PowerPoint presentation to begin the maintenance session. Participants were asked to sit in front of a computer screen as they did for each treatment session, and were instructed to use their left hand to make two circular movements, modeled after the hand movements utilized during the third week's treatment protocol, prior to naming the pictured object or action out loud. To continue to the next picture, participants were instructed to click the mouse or spacebar, using only their left hand. Participants were specifically instructed to not use their right hand for any purpose. Maintenance presentations were constructed in such a way that participants would not advance to the end of the presentation before the five minutes had passed. This construction was based upon the average number of objects and actions that each participant typically named per treatment session. Participants were also instructed to fill in a provided maintenance log after each maintenance session, which was shared on a Google Document with the investigator. The log consisted of sections where participants wrote in the date they completed their maintenance sessions, and any situations or stressors that may have had an effect on their fluency throughout the week. The maintenance log served as a tool for the investigator to keep track of each participant's attendance to the task.

5. Follow-Up (1 Session)

Follow-up speech samples were obtained from Participant 1 and Participant 2 seven weeks after the conclusion of the formal training treatment protocol. Each participant provided a total of eight speech samples, subsequently following procedures eliciting the four speech tasks, completed with and without the left-handed movement.

Design

This thesis study followed a descriptive, pre-post case study design in which participants completed one week of baseline measurements, three weeks of treatment, six weeks of independent maintenance without in-clinic treatment, and one week of follow-up measurements.

RESULTS

In order to answer the research question, the effects of the intention-focused training on two types of familiar and structured speech tasks are summarized. Data for each participant collected during each speech task are plotted in line graphs and summarized in tables. Figures 1, 2, 9, and 10 show the percentage of syllables affected by primary symptoms and/or secondary behaviors of stuttering. Figures 3, 4, 11, and 12 include the total number of disfluencies found during task analysis. Figures 5, 6, 13, and 14 show the percentage of syllables affected by a primary symptom of stuttering, regardless of whether or not a secondary behavior had occurred at the same time. Tables 3, 4, 7, and 8 show the total number of primary symptoms of stuttering. Figures 7, 8, 15, and 16 show the percentage of syllables affected solely by a secondary behavior of stuttering. Tables 5, 6, 9, and 10 show the total number of secondary behaviors of stuttering. Tables 11 and 12 show the occurrence of “mixed” symptoms and behaviors.

Familiar Reading Results (Rainbow Passage)

Figures 1 and 2 show the percentage of syllables affected by primary symptoms and/or secondary behaviors of stuttering regardless of incidence of co-occurrence during the Rainbow Passage task for each participant.

Results for Participant 1 show a decrease in percentage of affected syllables from pre-treatment to post-treatment to follow-up measures, as found in Figure 1. Results for Participant 2 show a decrease in percentage of affected syllables from pre-treatment to post-treatment and to follow-up measures when the hand movement was not included in the follow-up task. When the hand movement was included during follow-up measures, the percentage of affected syllables did not continue to decrease, but increased in comparison to post-treatment measures, as found in Figure 2.

Figures 3 and 4 include the total number of disfluencies found during task analysis during the Rainbow Passage task for each participant.

Results for Participant 1 show a decrease in the total number of disfluencies from pre-treatment to post-treatment to follow-up measures, as found in Figure 3. Results for Participant 2 show a decrease in percentage of affected syllables from pre-treatment to post-treatment and to follow-up measures, particularly when the hand movement was not included in the post-treatment and follow-up tasks, as found in Figure 4.

Figures 5 and 6 show the percentage of syllables affected by a primary symptom of stuttering, regardless of whether or not a secondary behavior had occurred at the same time, during the Rainbow Passage task for each participant.

Results for Participant 1 show a decrease in percentage of affected syllables from pre-treatment to post-treatment to follow-up measures, as found in Figure 5. Further, when Participant 1 utilized the hand movement during the task, the primary stutter symptoms occurred at a lower rate than when she did not utilize the hand movement. Results for Participant 2 show a decrease in percentage of affected syllables from pre-treatment to post-treatment and to follow-up measures, particularly when the hand movement was not included in the task during post-treatment and follow-up measures, as found in Figure 6.

The types of primary stuttering symptoms occurring throughout each task were also analyzed, as to determine any increase, maintenance, or decrease in specific primary symptoms over time.

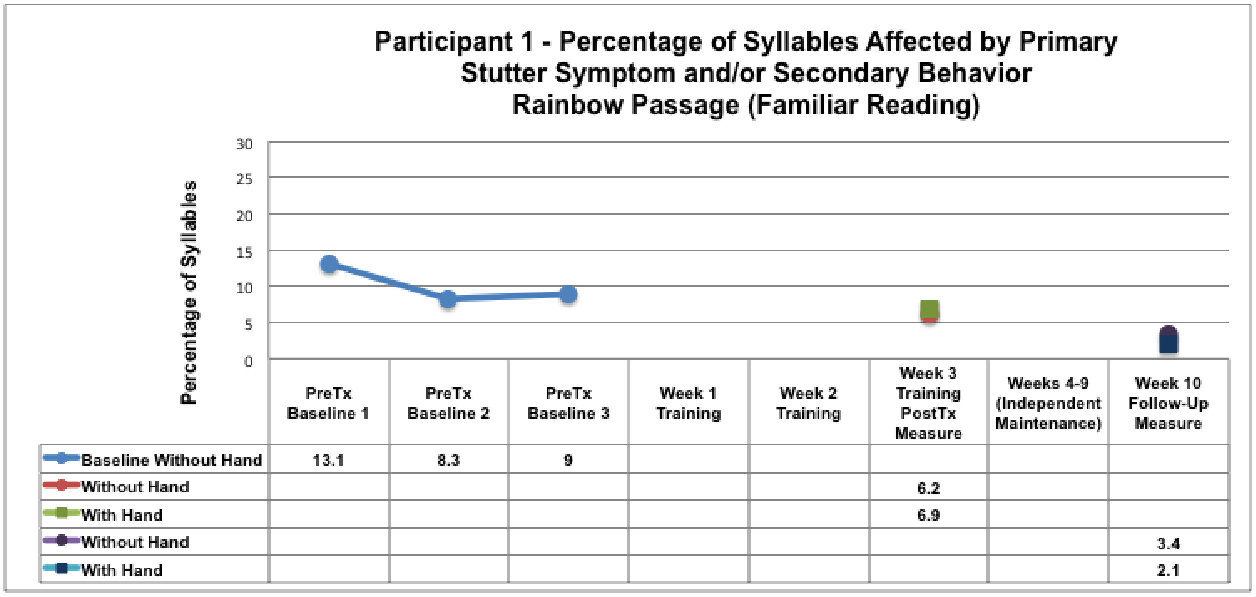
For Participant 1, the total number of primary stuttering symptoms from pre-treatment to post-treatment measures to follow-up measures decreased, as shown in Table 3. The primary symptom, "fixed with audible airflow," showed the greatest decrease in occurrence for Participant 1 in both post-treatment measures and follow-up measures, regardless of inclusion of the hand movement. The primary symptom, "fixed without audible airflow," remained consistent throughout all stages of treatment, through post-treatment measures, and without use of the hand movement in follow-up measures. When Participant 1 used her hand movement, she did not have an occurrence of the "fixed without audible airflow" primary symptom. For Participant 2, the total number of primary stuttering symptoms from pre-treatment to post-treatment measures to follow-up measures showed slight change in all but one primary stuttering symptom, as found in Table 4. From pre-treatment baseline measures to follow-up measures, there was a decrease in the primary symptom, "fixed without audible airflow," for Participant 2, when not accompanied by the hand movement. When the hand movement was included, a decrease occurred, however the change was not as considerable as the change noted with exclusion of the hand movement.

Figures 7 and 8 show the percentage of syllables affected solely by a secondary behavior of stuttering, during the Rainbow Passage task for each participant. As mentioned before, this percentage accounts for the number of actual syllables affected by secondary behaviors, excluding the volume of secondary behaviors that may have co-occurred with each syllable.

For Participant 1, results from pre-treatment to post-treatment to follow-up measures show a decrease in percentage when a hand movement did not accompany the task, found in Figure 7. When the hand movement was introduced to the task, percentages of syllables affected by secondary behaviors did not show change during post-treatment, and showed slight decrease during follow-up measures. For Participant 2, results from pre-treatment to post-treatment to follow-up measures do not show an overall change in percentage, as seen in Figure 8.

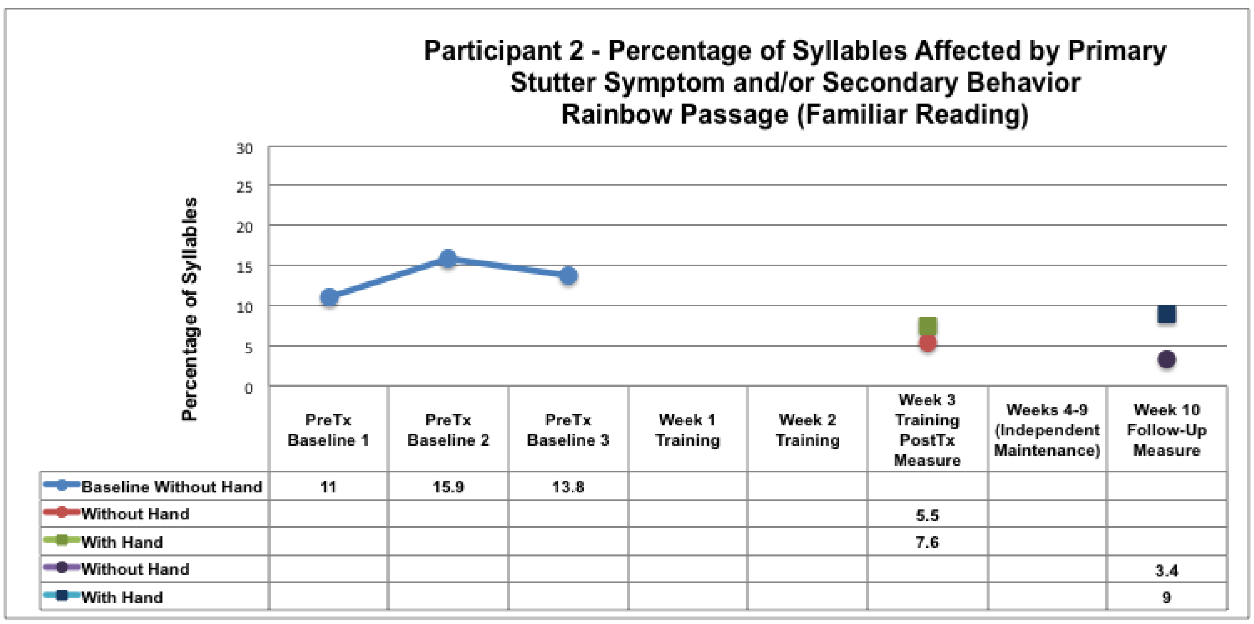
The types of secondary stuttering behaviors occurring throughout each task were also analyzed, as to determine any increase, maintenance, or decrease in specific secondary behaviors over time.

For Participant 1, the total number of nonverbal secondary behaviors decreased from pre-treatment baseline measures to follow-up measures, as evidenced in Table 5. The greatest decrease in occurrence of nonverbal behaviors was found in the number of head movements accompanying stuttering moments for Participant 1. For Participant 2, the total number of both verbal and nonverbal secondary behaviors decreased from pre-treatment baseline measures to follow-up measures, however, change was slight per specific behavior, as found in Table 6.



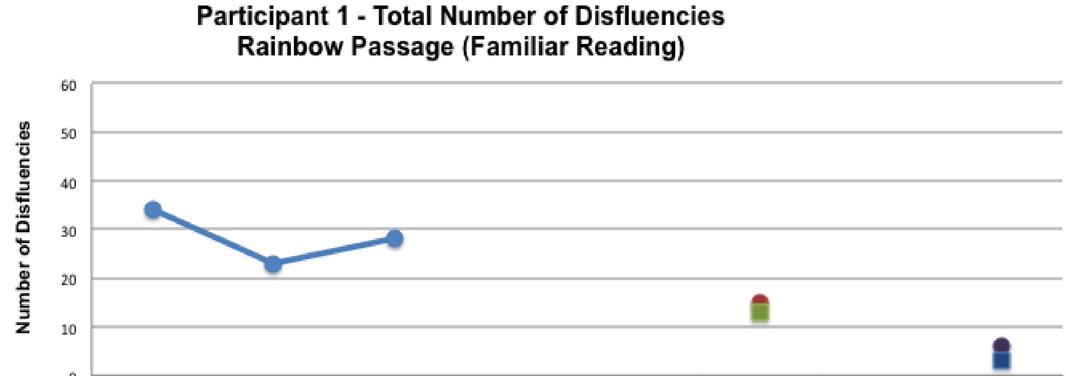
	PreTx Baseline 1	PreTx Baseline 2	PreTx Baseline 3	Week 1 Training	Week 2 Training	Week 3 Training PostTx Measure	Weeks 4-9 (Independent Maintenance)	Week 10 Follow-Up Measure
Baseline Without Hand	13.1	8.3	9					
Without Hand						6.2		
With Hand						6.9		
Without Hand								3.4
With Hand								2.1

Figure 1. Percentage of Syllables Affected by Primary Stutter Symptom and/or Secondary Behavior – Familiar Reading – Participant 1



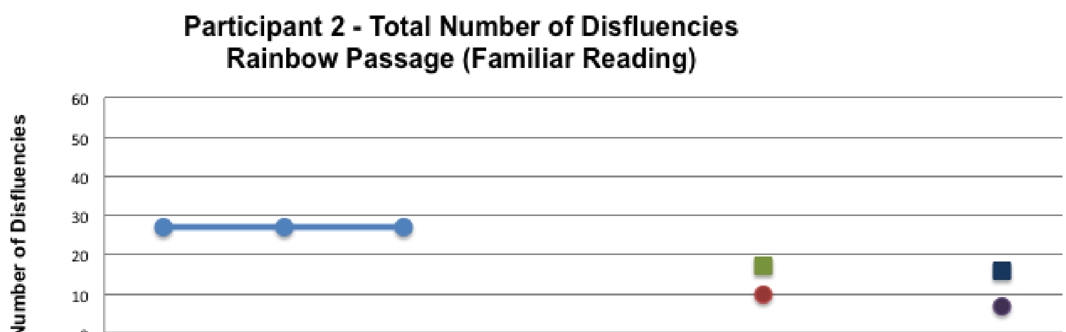
	PreTx Baseline 1	PreTx Baseline 2	PreTx Baseline 3	Week 1 Training	Week 2 Training	Week 3 Training PostTx Measure	Weeks 4-9 (Independent Maintenance)	Week 10 Follow-Up Measure
Baseline Without Hand	11	15.9	13.8					
Without Hand						5.5		
With Hand						7.6		
Without Hand								3.4
With Hand								9

Figure 2. Percentage of Syllables Affected by Primary Stutter Symptom and/or Secondary Behavior – Familiar Reading – Participant 2



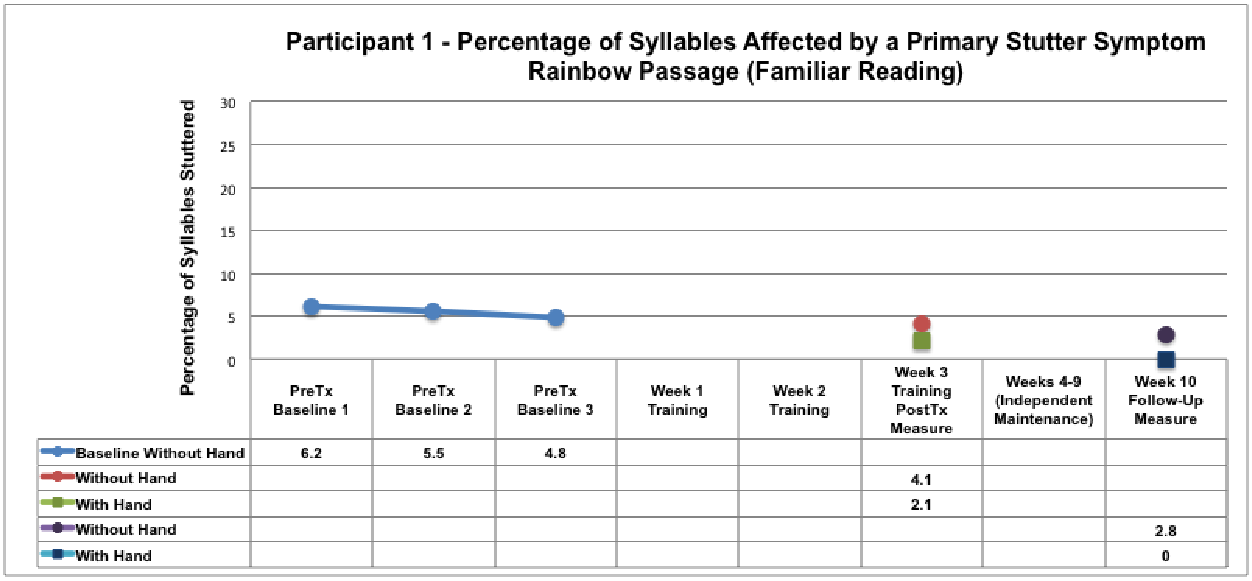
	PreTx Baseline 1	PreTx Baseline 2	PreTx Baseline 3	Week 1 Training	Week 2 Training	Week 3 Training PostTx Measure	Weeks 4-9 (Independent Maintenance)	Week 10 Follow-Up Measure
Baseline Without Hand	34	23	28					
Without Hand						15		
With Hand						13		
Without Hand								6
With Hand								3

Figure 3. Total Number of Disfluencies – Familiar Reading – Participant 1



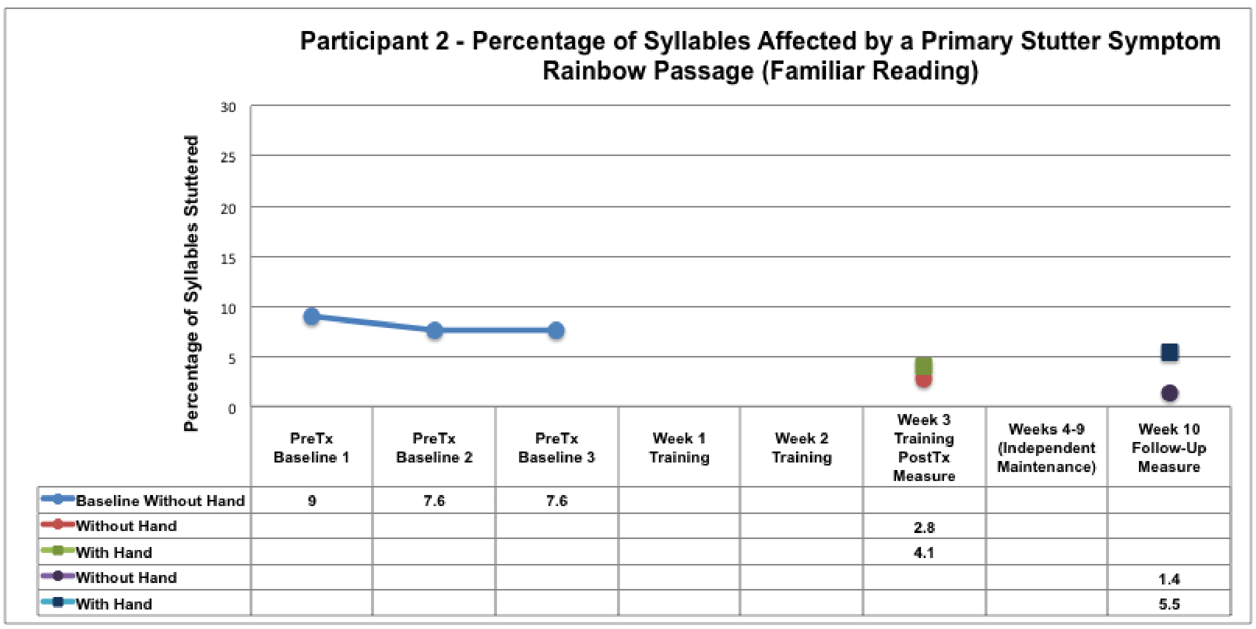
	PreTx Baseline 1	PreTx Baseline 2	PreTx Baseline 3	Week 1 Training	Week 2 Training	Week 3 Training PostTx Measure	Weeks 4-9 (Independent Maintenance)	Week 10 Follow-Up Measure
Baseline Without Hand	27	27	27					
Without Hand						10		
With Hand						17		
Without Hand								7
With Hand								16

Figure 4. Total Number of Disfluencies – Familiar Reading – Participant 2



	PreTx Baseline 1	PreTx Baseline 2	PreTx Baseline 3	Week 1 Training	Week 2 Training	Week 3 Training PostTx Measure	Weeks 4-9 (Independent Maintenance)	Week 10 Follow-Up Measure
Baseline Without Hand	6.2	5.5	4.8					
Without Hand						4.1		
With Hand						2.1		
Without Hand								2.8
With Hand								0

Figure 5. Percentage of Syllables Affected by a Primary Stutter Symptom – Familiar Reading – Participant 1



	PreTx Baseline 1	PreTx Baseline 2	PreTx Baseline 3	Week 1 Training	Week 2 Training	Week 3 Training PostTx Measure	Weeks 4-9 (Independent Maintenance)	Week 10 Follow-Up Measure
Baseline Without Hand	9	7.6	7.6					
Without Hand						2.8		
With Hand						4.1		
Without Hand								1.4
With Hand								5.5

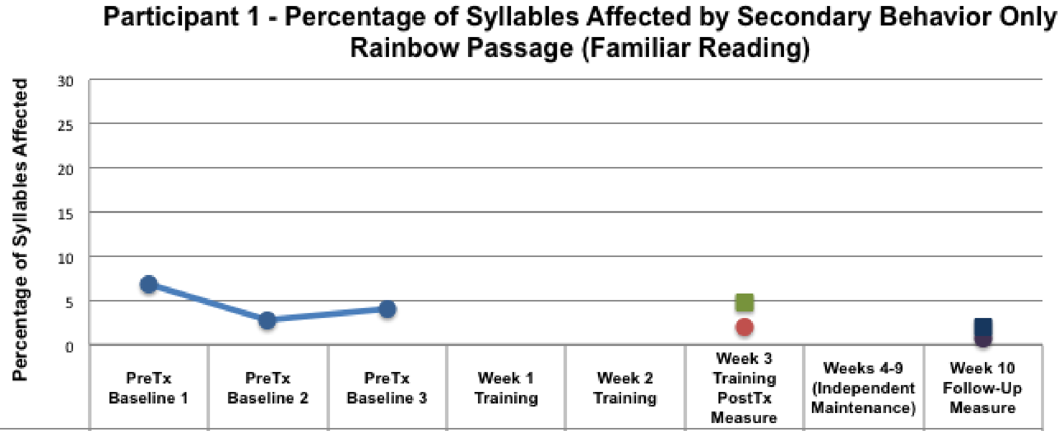
Figure 6. Percentage of Syllables Affected by a Primary Stutter Symptom – Familiar Reading – Participant 2

Table 3. Total Number of Primary Stuttering Symptoms by Type – Familiar Reading – Participant 1

Total Number of Primary Stuttering Symptoms by Type Participant 1 – Rainbow Passage Reading									
Type	**Pre-Treatment Baselines**				**Post-Treatment Measures**			**Follow-Up Measures**	
	1	**2**	**3**		**No Hand**	**Yes Hand**		**No Hand**	**Yes Hand**
SR	0	0	0		0	0		0	0
ISR	3	1	0		1	0		0	0
MUR	0	0	1		0	0		0	0
FWA	4	2	5		0	0		0	0
FWOA	2	5	3		5	3		4	0
TOTAL	**9**	**8**	**9**		**6**	**3**		**4**	**0**

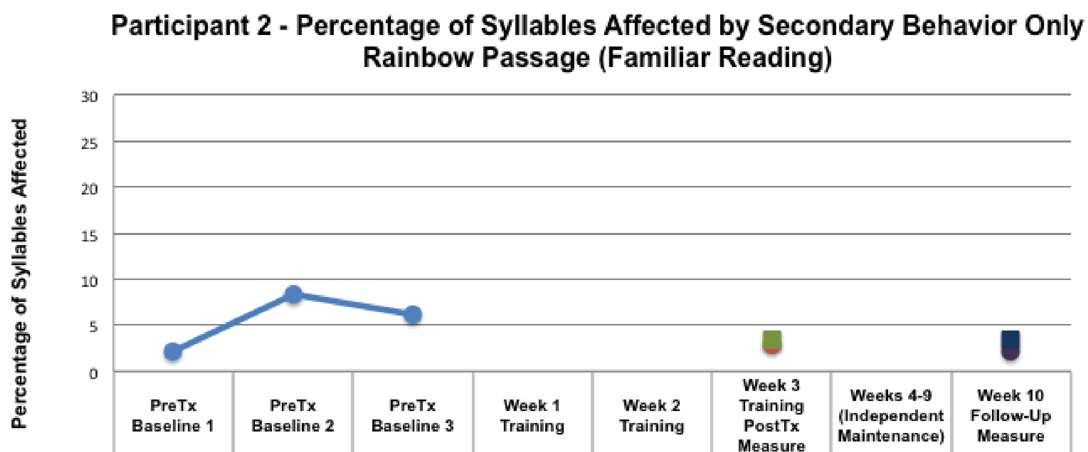
Table 4. Total Amount of Primary Stuttering Symptoms by Type – Familiar Reading – Participant 2

Total Number of Primary Stuttering Symptoms by Type Participant 2 – Rainbow Passage Reading									
Type	**Pre-Treatment Baselines**				**Post-Treatment Measures**			**Follow-Up Measures**	
	1	**2**	**3**		**No Hand**	**Yes Hand**		**No Hand**	**Yes Hand**
SR	1	0	1		0	1		0	0
ISR	2	0	2		1	1		0	0
MUR	0	0	1		0	1		0	0
FWA	0	0	1		0	0		0	0
FWOA	12	11	8		3	4		2	8
TOTAL	**15**	**11**	**13**		**4**	**7**		**2**	**8**



	PreTx Baseline 1	PreTx Baseline 2	PreTx Baseline 3	Week 1 Training	Week 2 Training	Week 3 Training PostTx Measure	Weeks 4-9 (Independent Maintenance)	Week 10 Follow-Up Measure
Baseline Without Hand	6.9	2.8	4.1					
Without Hand						2.1		
With Hand						4.8		
Without Hand								0.7
With Hand								2.1

Figure 7. Percentage of Syllables Affected by Secondary Behavior Only – Familiar Reading – Participant 1



	PreTx Baseline 1	PreTx Baseline 2	PreTx Baseline 3	Week 1 Training	Week 2 Training	Week 3 Training PostTx Measure	Weeks 4-9 (Independent Maintenance)	Week 10 Follow-Up Measure
Baseline Without Hand	2.1	8.3	6.2					
Without Hand						2.8		
With Hand						3.4		
Without Hand								2.1
With Hand								3.4

Figure 8. Percentage of Syllables Affected by Secondary Behavior Only – Familiar Reading – Participant 2

Table 5. Total Number of Secondary Behaviors by Type – Familiar Reading – Participant 1

Total Number of Secondary Behaviors by Type Participant 1 – Rainbow Passage Reading									
Type	**Pre-Treatment Baselines**				**Post-Treatment Measures**			**Follow-Up Measures**	
	1	**2**	**3**		**No Hand**	**Yes Hand**		**No Hand**	**Yes Hand**
VERBAL									
Filler	0	0	0		0	0		0	0
Distortion	0	0	0		0	0		0	0
Substitution	0	0	0		0	0		0	0
(Subtotal)	0	0	0		0	0		0	0
NONVERBAL									
Head	13	6	6		5	5		1	0
Eye	2	3	6		2	2		0	2
Brow	8	4	6		1	2		1	1
Swallow	2	1	1		1	1		0	0
Grimace	0	1	0		0	0		0	0
(Subtotal)	25	15	19		9	10		2	3
TOTAL	**25**	**15**	**19**		**9**	**10**		**2**	**3**

Table 6. Total Amount of Secondary Behaviors by Type – Familiar Reading – Participant 2

Total Amount of Secondary Behaviors by Type Participant 2 – Rainbow Passage Reading									
Type	**Pre-Treatment Baselines**				**Post-Treatment Measures**			**Follow-Up Measures**	
	1	**2**	**3**		**No Hand**	**Yes Hand**		**No Hand**	**Yes Hand**
VERBAL									
Filler	1	0	1		0	0		0	0
Distortion	1	1	0		0	1		0	0
Substitution	1	0	1		0	0		0	0
(Subtotal)	3	1	2		0	1		0	0
NONVERBAL									
Head	4	10	6		3	2		3	3
Eye	4	4	3		2	4		1	5
Brow	0	0	3		0	2		1	0
Swallow	0	1	0		0	1		0	0
Nostril	1	0	0		0	0		0	0
Deletion	0	0	0		1	0		0	0
(Subtotal)	9	15	12		6	9		5	8
TOTAL	**12**	**16**	**14**		**6**	**10**		**5**	**8**

Structured Retell Results (Charlie Chaplin)

Figures 9 and 10 show the percentage of syllables affected by primary symptoms and/or secondary behaviors of stuttering regardless of incidence of co-occurrence during the Charlie Chaplin task for each participant.

Results for Participant 1 indicate no major change over time, as indicated in Figure 9. However, a decrease in the percentage of syllables affected by primary stuttering symptoms and/or secondary behaviors is found during post-treatment and follow-up measures when the hand movement was included in the task, as shown in Figure 9. Results for Participant 2 show a decrease in the percentage of syllables affected by primary stuttering symptoms and/or secondary behaviors without inclusion of the hand movement during post-treatment, and regardless of inclusion of hand movement during follow-up measures, as shown in Figure 10.

Figures 11 and 12 include the total number of disfluencies found during task analysis during the Charlie Chaplin task for each participant.

Results for Participant 1 show a decrease in the total number of disfluencies with inclusion of the hand movement during post-treatment, and regardless of inclusion of the hand movement during follow-up measures, as shown in Figure 11. For Participant 2, results from pre-treatment to post-treatment to follow-up measures show slight decrease during post-treatment and during follow-up measures, as seen in Figure 12.

Figures 13 and 14 show the percentage of syllables affected by a primary stutter symptom for each participant, even if a secondary behavior happened to co-occur with the primary symptom.

Results from Participant 1 show a difference in percentages when the hand movement accompanied the task, as found in Figure 13. There was no relevant decrease in percentage of syllables affected by a primary stutter when she did not include the hand movement, or when the hand movement was used during post-treatment measures. However, from pre-treatment to follow-up measures, a decrease in percentage of syllables affected by a primary stutter was found when Participant 1 utilized the hand movement during the task. For Participant 2, a decrease in percentage of syllables affected from pre-treatment to post-treatment is indicated when the hand movement was included during post-treatment, and when no hand movement was included in the task during follow-up measures, found in Figure 14.

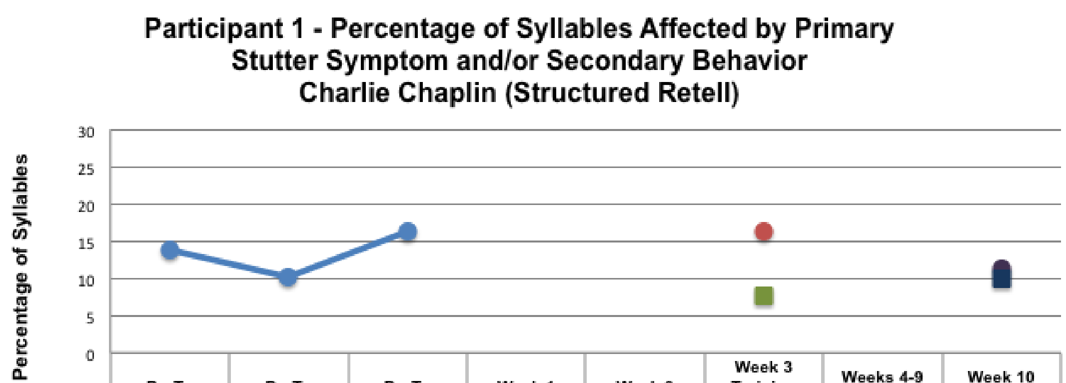
Primary stuttering symptoms occurring throughout each task were also analyzed by type, in order to determine any increase, maintenance, or decrease in specific primary stuttering symptoms over time.

From pre-treatment to post-treatment to follow-up measures for Participant 1, there was a decrease in the total amount of primary stuttering symptoms, when she included the hand movement in the retell task, as seen in Table 7. In particular, the greatest change was found in the occurrence of the fixed without audible airflow symptom, which decreased from an average of four instances during baseline measures, to no indication of occurrence during follow-up measures when the hand movement was included. However, when the hand movement was not included during follow-up measures, there was no change in the total amount of the fixed without audible airflow symptom. Participant 2 showed a varying degree of decrease in the occurrence of primary stuttering symptoms over time, as found in Table 8, particularly when no hand movement was included in the task.

Figures 15 and 16 show the percentage of syllables affected solely by a secondary behavior of stuttering, during the Charlie Chaplin task for each participant. As mentioned before, this percentage accounts for the number of actual syllables affected by secondary behaviors, excluding the volume of secondary behaviors that may have co-occurred with each syllable.

During the Charlie Chaplin task, Participant 1 did not show an overall change in the percentage of syllables affected solely by secondary behaviors. However, a slight decrease in the percentage of syllables affected by secondary behaviors is found during post-treatment measures when the hand movement was included in the task, as seen in Figure 15. For Participant 2, there were no changes in the percentage of syllables affected solely by secondary behaviors, regardless if the hand movement was included, as found in Figure 16.

Secondary stuttering behaviors occurring throughout each task were analyzed, in order to determine any increase, maintenance, or decrease in specific secondary behaviors over time. The total numbers of secondary behaviors can be found in Tables 9 and 10. For Participant 1, the amount of verbal secondary behaviors showed no substantial change over time, as indicated in Table 9. Though few changes were found when analyzing nonverbal behaviors, a decrease in the number of head movements, eye movements, and brow movements were indicated, while other nonverbal behaviors showed little to no change. Overall, the total amount of secondary behaviors did show a decrease from pre-treatment to follow-up measures. For Participant 2, there was a change indicated in the occurrence of filler words from pre-treatment to follow-up measures when no hand movement was included in the task, found in Table 10. There were no major changes in any other verbal or nonverbal secondary behavior for Participant 2. Overall, the total number of secondary behaviors showed a decrease when the hand movement did not accompany the task.



	PreTx Baseline 1	PreTx Baseline 2	PreTx Baseline 3	Week 1 Training	Week 2 Training	Week 3 Training PostTx Measure	Weeks 4-9 (Independent Maintenance)	Week 10 Follow-Up Measure
Baseline Without Hand	13.7	10.1	16.4					
Without Hand						16.2		
With Hand						7.7		
Without Hand								11.3
With Hand								9.9

Figure 9. Percentage of Syllables Affected by Primary Stutter Symptom and/or Secondary Behavior – Structured Retell – Participant 1

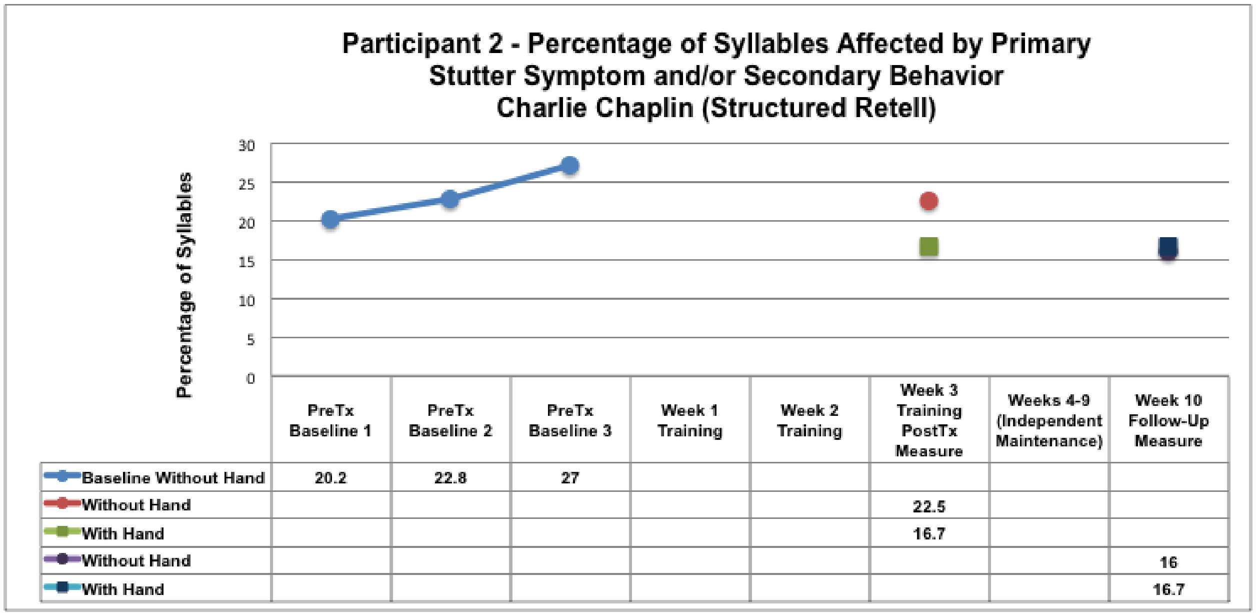


Figure 10. Percentage of Syllables Affected by Primary Stutter Symptom and/or Secondary Behavior – Structured Retell – Participant 2

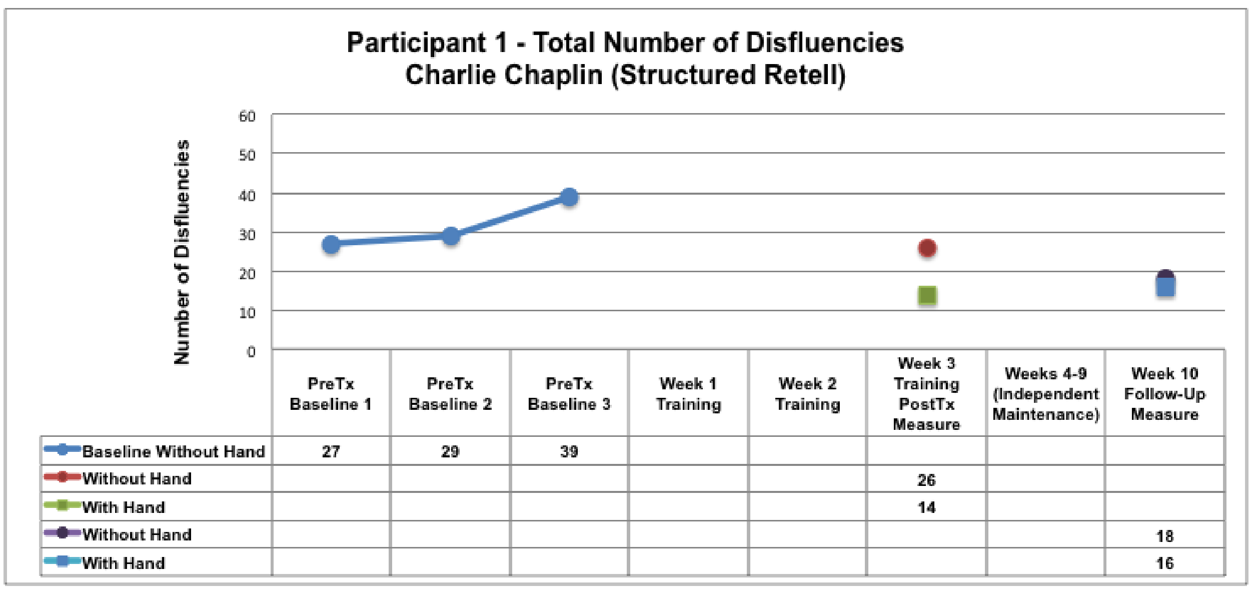
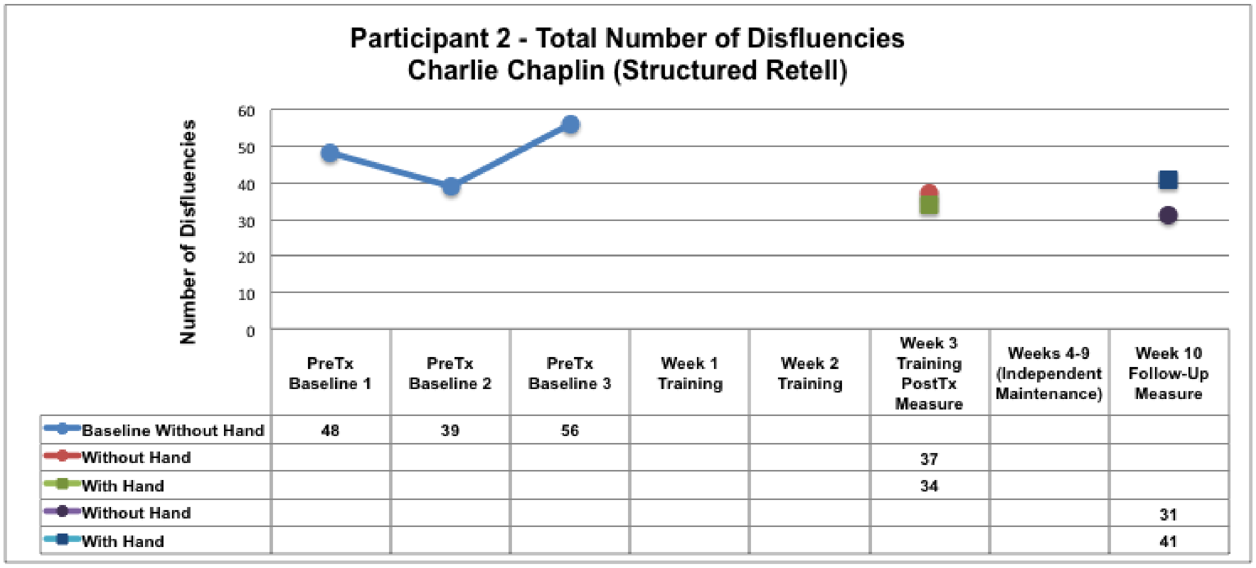
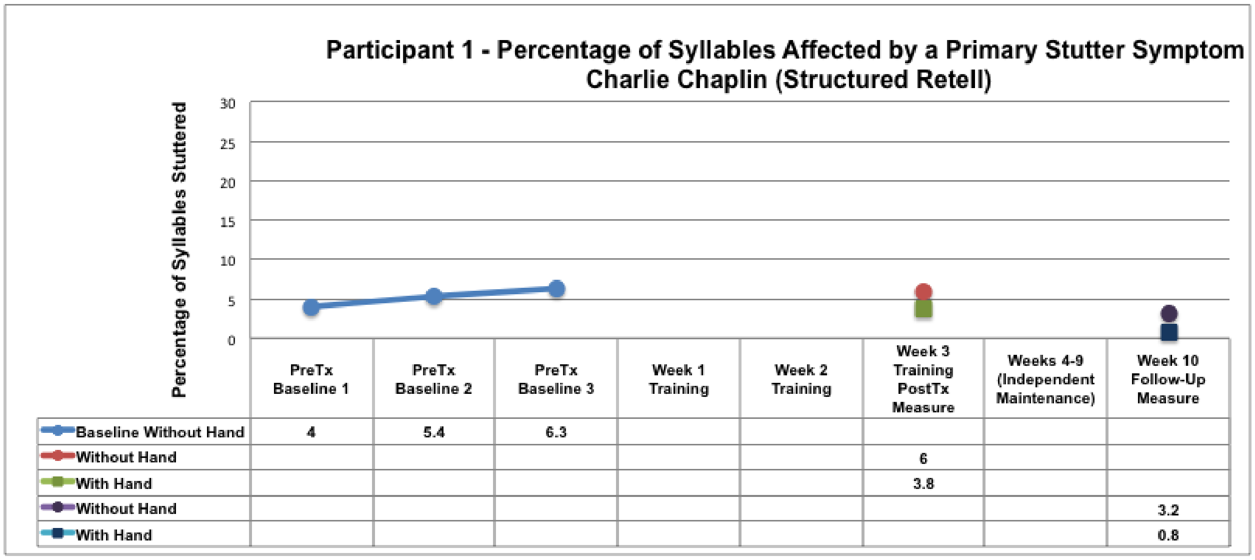


Figure 11. Total Number of Disfluencies – Structured Retell – Participant 1



	PreTx Baseline 1	PreTx Baseline 2	PreTx Baseline 3	Week 1 Training	Week 2 Training	Week 3 Training PostTx Measure	Weeks 4-9 (Independent Maintenance)	Week 10 Follow-Up Measure
Baseline Without Hand	48	39	56					
Without Hand						37		
With Hand						34		
Without Hand								31
With Hand								41

Figure 12. Total Number of Disfluencies – Structured Retell – Participant 2



	PreTx Baseline 1	PreTx Baseline 2	PreTx Baseline 3	Week 1 Training	Week 2 Training	Week 3 Training PostTx Measure	Weeks 4-9 (Independent Maintenance)	Week 10 Follow-Up Measure
Baseline Without Hand	4	5.4	6.3					
Without Hand						6		
With Hand						3.8		
Without Hand								3.2
With Hand								0.8

Figure 13. Percentage of Syllables Affected by a Primary Stutter Symptom – Structured Retell – Participant 1

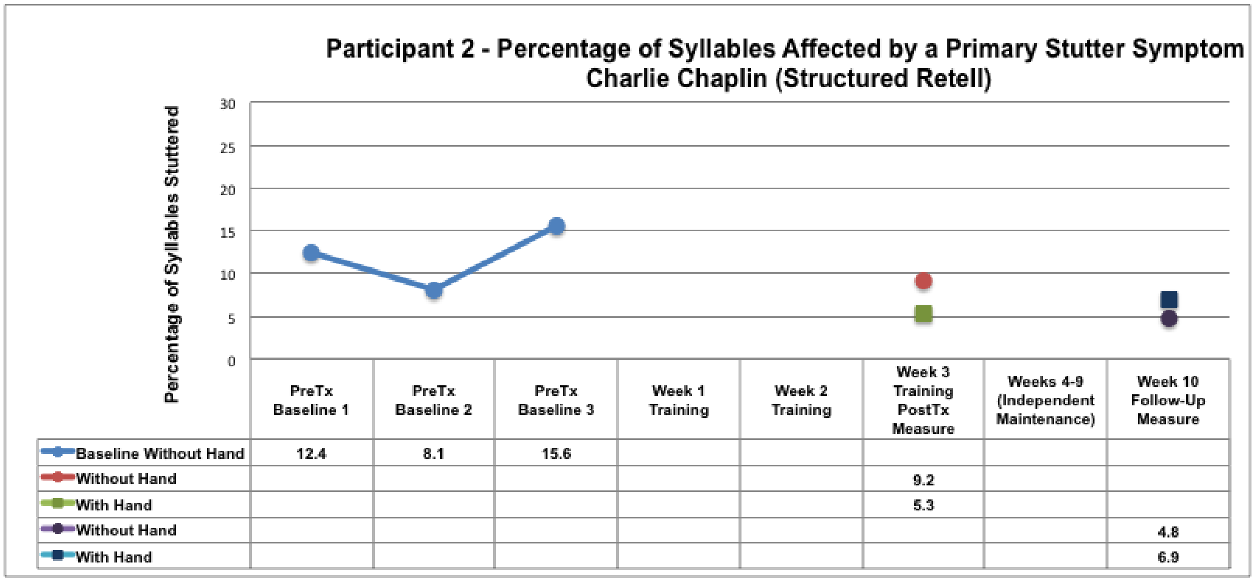


Figure 14. Percentage of Syllables Affected by a Primary Stutter Symptom – Structured Retell – Participant 2

Table 7. Total Number of Primary Stuttering Symptoms by Type – Structured Retell – Participant 1

Total Number of Primary Stuttering Symptoms by Type Participant 1 – Charlie Chaplin Retell									
Type	**Pre-Treatment Baselines**				**Post-Treatment Measures**			**Follow-Up Measures**	
	1	**2**	**3**		**No Hand**	**Yes Hand**		**No Hand**	**Yes Hand**
SR	0	0	3		1	1		0	1
ISR	0	0	0		0	0		0	0
MUR	0	3	0		0	0		0	0
FWA	0	2	1		2	1		0	0
FWOA	5	3	4		4	3		4	0
TOTAL	**5**	**8**	**8**		**7**	**5**		**4**	**1**

Table 8. Total Number of Primary Stuttering Symptoms by Type – Structured Retell – Participant 2

Total Number of Primary Stuttering Symptoms by Type Participant 2 – Charlie Chaplin Retell									
Type	**Pre-Treatment Baselines**				**Post-Treatment Measures**			**Follow-Up Measures**	
	1	**2**	**3**		**No Hand**	**Yes Hand**		**No Hand**	**Yes Hand**
SR	10	2	11		5	4		3	6
ISR	0	3	5		1	0		0	0
MUR	0	0	1		0	0		0	1
FWA	0	0	0		0	0		0	0
FWOA	6	5	5		5	3		4	3
TOTAL	**16**	**10**	**22**		**11**	**7**		**7**	**10**

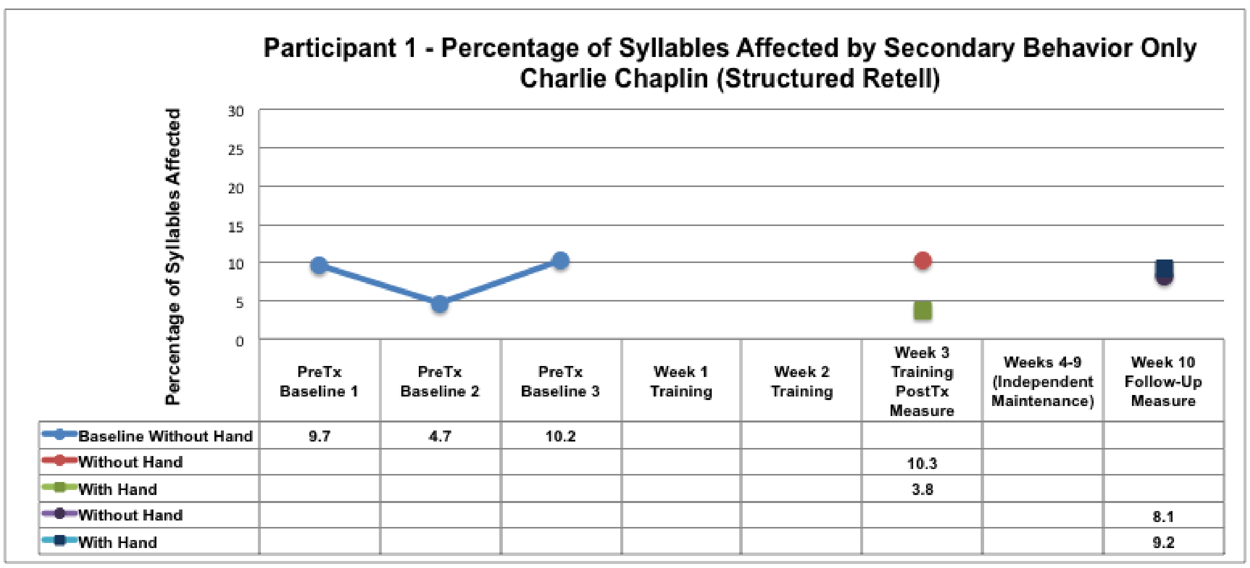


Figure 15. Percentage of Syllables Affected by Secondary Behavior Only – Structured Retell – Participant 1

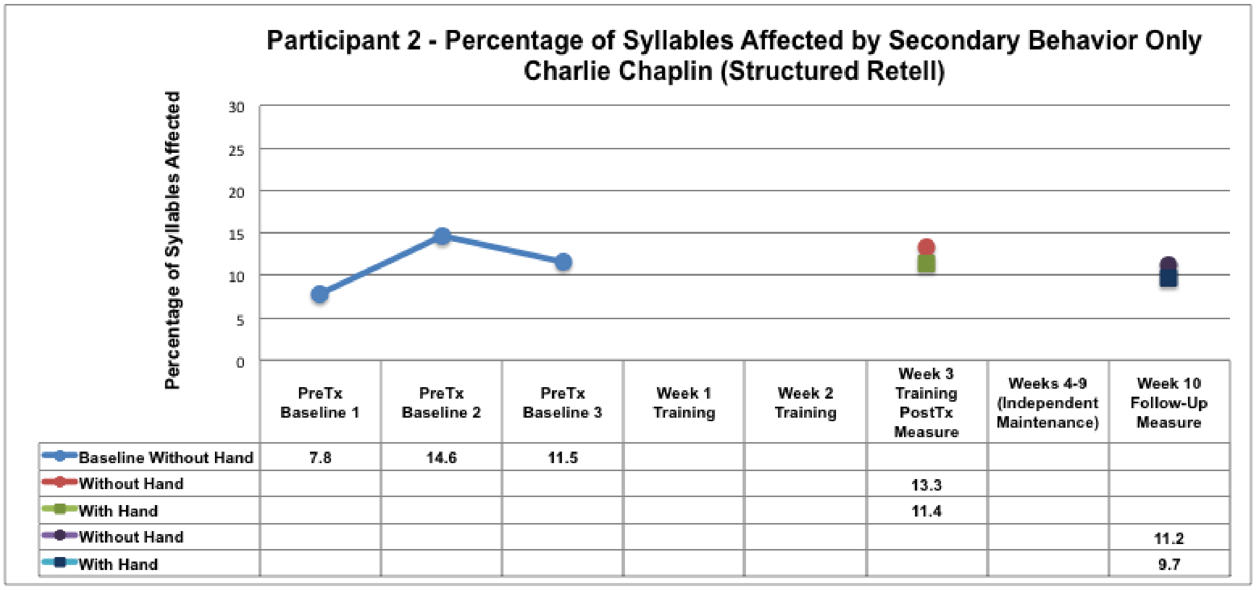


Figure 16. Percentage of Syllables Affected by Secondary Behavior Only – Structured Retell – Participant 2

Table 9. Total Number of Secondary Behaviors by Type – Structured Retell – Participant 1

Total Number of Secondary Behaviors by Type Participant 1 – Charlie Chaplin Retell							
Type	**Pre-Treatment Baselines**			**Post-Treatment Measures**		**Follow-Up Measures**	
	1	**2**	**3**	**No Hand**	**Yes Hand**	**No Hand**	**Yes Hand**
VERBAL							
Filler	6	8	6	4	6	4	8
Switch	1	0	2	0	1	0	0
Giggle	1	2	3	3	0	1	2
Distortion	0	0	0	1	0	0	0
Glottal Noise	0	0	0	0	0	1	0
(Subtotal)	8	10	11	8	7	6	10
NONVERBAL							
Head	8	7	4	4	1	4	2
Eye	0	3	5	1	0	0	0
Brow	4	1	3	3	1	1	0
Swallow	0	0	1	0	0	0	0
Grimace	0	0	0	1	0	0	0
Hand	2	0	7	2	0	3	0
Shoulder	0	0	0	0	0	0	2
Arm	0	0	0	0	0	0	1
(Subtotal)	14	11	20	11	2	8	5
TOTAL	**22**	**21**	**31**	**19**	**9**	**14**	**15**

Table 10. Total Number of Secondary Behaviors by Type – Structured Retell – Participant 2

Total Number of Secondary Behaviors by Type Participant 2 – Charlie Chaplin Retell									
Type	**Pre-Treatment Baselines**				**Post-Treatment Measures**			**Follow-Up Measures**	
	1	**2**	**3**		**No Hand**	**Yes Hand**		**No Hand**	**Yes Hand**
VERBAL									
Filler	9	11	14		8	10		5	10
Switch	0	0	0		0	1		0	0
Distortion	0	0	1		0	0		0	0
(Subtotal)	9	11	15		8	11		5	10
NONVERBAL									
Head	9	3	8		4	3		5	6
Eye	11	12	7		12	7		6	12
Brow	3	3	4		2	6		7	2
Swallow	0	0	0		0	0		1	1
(Subtotal)	23	18	19		18	16		19	21
TOTAL	**32**	**29**	**34**		**26**	**27**		**24**	**31**

Additional Measurement Results

Finally, the occurrence of “mixed” symptoms and behaviors were examined for both the Rainbow Passage task and the Charlie Chaplin task. Mixed symptoms and behaviors were measured as moments of more than one primary stuttering and/or secondary behavior occurring at the same time.

For Participant 1 and Participant 2, little change in the amount of mixed symptoms and behaviors occurred over time. The numbers decreased from pre-treatment to follow-up measures for Participant 1 throughout both tasks, as shown in Table 11. The numbers from pre-treatment to follow-up measures for Participant 2 showed no change for either task as shown in Table 12.

Table 11. Moments of More Than One Primary Stuttering and/or Secondary Behavior Occurring at the Same Time – "Mixed" – Participant 1

Moments of More Than One Primary Stuttering and/or Secondary Behavior Occurring at the Same Time "Mixed" Participant 1									
Task	**Pre-Treatment Baselines**				**Post-Treatment Measures**			**Follow-Up Measures**	
	1	**2**	**3**		**No Hand**	**Yes Hand**		**No Hand**	**Yes Hand**
Rainbow Passage (Familiar Reading)	10	6	6		5	3		4	0
Charlie Chaplin (Structured Retell)	7	4	8		5	3		3	2

Table 12. Moments of More Than One Primary Stuttering and/or Secondary Behavior Occurring at the Same Time – "Mixed" – Participant 2

Moments of More Than One Primary Stuttering and/or Secondary Behavior Occurring at the Same Time "Mixed" Participant 2									
Task	**Pre-Treatment Baselines**				**Post-Treatment Measures**			**Follow-Up Measures**	
	1	**2**	**3**		**No Hand**	**Yes Hand**		**No Hand**	**Yes Hand**
Rainbow Passage (Familiar Reading)	6	4	2		1	4		2	3
Charlie Chaplin (Structured Retell)	10	5	11		7	4		5	7

DISCUSSION

The aim of the current investigation was to incorporate a novel fluency intervention based upon neural imaging data which suggests that the right hemisphere homologue to Broca's area, along with other right-hemisphere premotor areas, were more active in PWS than in PWNS during fluent speech events, and that a shift in lateralization to the right hemisphere for activation of language and speech areas may occur during fluent speech (Belyk et al., 2015). The intention-focused treatment developed by Crosson and colleagues was implemented during the investigation in order to promote additional right hemisphere involvement during speaking tasks. During this study, frequency of stuttering events was measured during two modes of speaking tasks: familiar reading and structured retell. Overall, results of the intention-focused treatment indicate a general decrease in stuttering events for both participants.

Successful intervention for stuttering has been a consistent focus of ongoing research. Current treatment approaches that deliver favorable outcomes typically involve a multi-factorial schematic, classically including an intensive treatment schedule involving initial therapy within a clinic, practicing in front of groups, carryover tasks, self-evaluation, self-management, and naturalness of speech (Bothe et al., 2006). However, intensive treatment can be daunting, exhausting, and time consuming. Further, following an intensive treatment program, skills must also often be generalized to a person's daily life during maintenance periods. This may involve an intense amount of self-initiated motivation and self-initiated regulation of the newly acquired thought processes involved in speaking tasks. The demands of attention and intention may increase, as the PWS must consciously formulate and execute a code for fluent speech, on demand, as they are immersed in a speaking task. The future of stuttering intervention research will benefit from a shift in focus to treatment approaches that deliver fluency gains with a much less intense treatment workload and demand.

Commonalities and Differences Between Participants' Results

The two participants presented with a variety of differences and commonalities overall. Participant 1 received ten treatment sessions per week for a total of 30 treatment sessions adding up to 15 hours of treatment, while Participant 2 received six treatment sessions per week for a total of 18 treatment sessions adding up to nine hours of treatment. Therefore, it is unknown whether Participant 2 would have shown additional fluency gains if she had been able to enroll in the full treatment schedule. It is also important to keep note, while reviewing commonalities and differences in results, that Participant 1 is left-handed, while Participant 2 is right-handed. If Participant 1 and Participant 2 do not share common handedness, their individual results may be better compared with data from PWS who share common handedness, due to the possibility of differences in neural correlates and activations as suggested by their differences in motor dominance. Further, the amount of previous treatment for stuttering differs between participants. Participant 1 completed treatment for stuttering through twelfth grade in the public school system, while Participant 2 has had no formal treatment targeting stuttering specifically.

Concluding results from the familiar read-aloud (Rainbow Passage) task indicate that resulting data from both participants indicate a decrease from pre-treatment baseline measures to post-treatment measures and through follow-up measures in percentage of syllables affected by a primary stutter, specifically when the hand movement was included during the task for Participant 1 and when the hand movement was excluded from the task for Participant 2. Concluding results from the structured retell (Charlie Chaplin) task indicate a slight decrease from pre-treatment baseline measures to follow-up measures for Participant 1 specifically when the task was accompanied by the hand movement during follow-up measures.

Both participants showed decreases in the total number of disfluencies during the familiar reading task (Rainbow Passage). However, it is important to note the continual decline in primary stuttering symptoms over time during baseline measures for both participants. This may be attributed to the familiarity of the task content, also referred to as the adaptation effect, which may be a result of motor learning due to sequential repetition of motor speech movements (Max & Baldwin, 2010). The outcome expected as a result of the adaptation effect in the participants in the current study is an increase in fluency occurring over time (Max & Baldwin, 2010).

During the Rainbow Passage task, both participants had decreases in the total number of primary stuttering symptoms during follow-up measures, particularly when Participant 1 included the left-handed movement during the task and when Participant 2 did not include the left-handed movement during the task.

During the structured retell task (Charlie Chaplin), both participants showed a decrease in the total number of primary stuttering symptoms during follow-up measures.

Again, as previously mentioned, data from Participant 1 showed more fluency gains when including the hand movement while Participant 2 made more gains in fluency when not including the hand movement. Results from both participants' data during the Charlie Chaplin task show little to no change overall, in terms of measuring the percentage of syllables affected by a primary stutter, although it is worth mentioning to note that Participant 1 did show a decrease solely in the percentage of syllables affected by a primary stutter during follow-up measures, when the hand movement was included in the task.

Comparing and Contrasting Between Interventions

Many current evidenced based treatment programs for developmental stuttering require attendance of 60 to 100 hours of intensive therapy split over the course of two to three weeks (Blomgren et al., 2005; Blomgren, 2010; Blomgren, 2013; Boberg, 1994). While in the treatment phase, the person who stutters will learn to focus on many factors simultaneously, while speaking, in order to control or manipulate their fluency. Some of the factors include achieving a stretched syllable target in order to increase awareness of speech in order to modify if necessary, achieving a gentle phonatory onset target in order to initiate vocal fold vibration in a specifically composed manner, targeting reduced articulatory pressure in order to promote smooth transitions between speech sounds within running speech, targeting full breath during speech, focusing on smooth articulatory change, utilizing continuous phonation, targeting full articulatory movement, maintaining eye contact, openly acknowledging one's stutter with listeners, pseudo stuttering, terminating a stuttering moment on purpose, and/or cancelling a stuttered word by attempting the word again fluently (Blomgren, 2013). As one can imagine, the amount of self-monitoring, focused attention, and divided attention during a regulated speaking task can be thoroughly grueling.

A treatment focusing on strengthening and/or shifting neural correlates in order to produce an environment that is conducive to more fluent speech may prove to be far less intensive than traditional stuttering treatment. The intention-focused treatment used in the current study is less time consuming, preferably completed in six weeks, including one 45-minute session per day, five days per week. This schedule adds up to 22.5 hours total for the entire intention-focused treatment, and when comparing to an intensive stuttering treatment program consisting of 60 to 100 hours over the course of two to three weeks, the intention-focused treatment may prove to be more temporally achievable for the average person. Moreover, the intention-focused treatment does not place a heavy demand on attention during speaking, does not involve a heavy dose of self-monitoring when speaking, does not emphasize prolonged speech tasks, and does not require phonatory control of voicing, precise control of each articulatory placement, or smooth transitions into the next phoneme. The intention-focused treatment may require less demand on encoding and executing a formula for fluency during speech.

A feature of the intention-focused treatment that may be appealing to some PWS is that the treatment does not have to be held within a group setting. Individual treatment can be accommodated easily. People are also not expected to perform within-clinic and beyond-clinic tasks such as making phone calls or talking to unknown listeners with the intention-focused treatment. However, this approach may be considered to be monotonous, less engaging, and even boring in comparison to the traditional stuttering treatment approaches. There is also no emphasis on a heavy maintenance program that requires intense self-monitoring of precise tasks during speech, although maintenance for the intention-focused treatment warrants further investigation.

The proposed outcome for the intention-focused treatment is for the right hemisphere of the brain to become more involved in speaking events, through utilization of the left hand movement. This will hopefully result in the right hemisphere taking charge of speech as plasticity takes its course, eventually leading to a decrease in necessity for the hand movement at all.

Study Limitations

As a novel treatment for stuttering, this preliminary study presents with various limitations. Ideally, the current study would have included a sample size large enough to obtain and analyze trends across individual data that could be further evaluated in terms of gender. Due to scheduling conflicts and demands placed upon potential participants, the sample size for this study was limited to two subjects, one of whom was only available for a reduced amount of treatment sessions. Secondary to the amount of time required to analyze each facet of the data collected was the task of deciphering whether various movements made by the participants during data collection were due to secondary stuttering behaviors, anxiety, or if they were part of the general nature of the participants' communicating styles. Secondary stuttering behaviors occur simultaneously with stutter events, however, extraneous movements can occur at any time during speech. Therefore, it is difficult to determine if an extraneous movement would be considered to be secondary in nature if a primary stuttering symptom had been suppressed by the movement.

Clinical Implications and Future Directions

Current evidence gathered from this novel treatment study suggests the potential for gains in fluency management treatment options; however, limited information was collected during this study due to the small sample size and the participants' scheduling availability. Due to the limited number of participants, information regarding whether this type of treatment for stuttering would work for a larger number of participants is unable to be predicted.

Considering the results from this study, further research is warranted for an expansion to a more comprehensive understanding of what is happening in the neural realm when participants undergo a neural based therapeutic approach such as the intention-focused treatment. Additionally, in order to truly gain information regarding changes in hemispheric lateralization, neural imaging may be considered, as pre-treatment and post-treatment measures to better correlate any brain activity changes with noted changes in fluency.

Use of Crosson and colleagues' attention intervention may also yield additional information regarding right brain stimulation, activation, and lateralization. During the attention intervention, participants do not utilize a left hand movement, rather, upon prompting, will turn their head and eyes toward a computer screen placed within their left visual field before naming the picture presented on the screen. Outcomes for the intention-focused treatment as well as the attention treatment proved to be successful in increasing naming accuracy in the participants with anomic aphasia (Crosson et al., 2007). However, depending on the participants' severity of word-finding impairment, differences between the results from the intention-focused and attention-focused treatments either showed little variance in gains, or larger gains made in naming accuracy when participants underwent the intention-focused treatments (Crosson et al., 2007). Therefore, further research is warranted in order to gain insight into how the intention-focused and attention-focused interventions fare with PWS. Results may show insightful differences in stimulation and lateralization that occur when a left-handed movement is included versus when a stimulus is presented in the left visual field. Due to time limitations, the attention treatment phases were not included in this study.

Introducing a control intervention into the study could also be beneficial to indicate the degree of effectiveness that this neural based treatment may potentially have on PWS. For future studies, control intervention options could include an evidence based intense stuttering treatment program, or perhaps inclusion of the attention-focused training on half of the participants in a crossover design. As warranted, a control intervention may be included in future reproductions of a neural based stuttering treatment study.

Another factor to consider evaluating in future endeavors that may bring about interesting results is the analysis of data by gender. In the study published in 2007, Crosson and colleagues obtained results from 17 male and 17 female participants. However, results were not discussed per gender, but rather exclusively per severity of word-finding impairment of moderate-severe severity or profound severity (Crosson et al., 2007). When looking over results, particularly for stuttering interventions, it may be beneficial to further analyze data per gender, as more males than females stutter, and the gender ratio increases as age increases from approximately 2:1 male to female around onset of stuttering to 4 or 5:1 male to female prevalence in adulthood (Ambrose, Cox, & Yairi, 1997). There may be a multitude of reasons for why the ratio continues to rise with age. Perhaps insight can be drawn from separating results by gender; for the reason that, for instance, there may be a possibility that additional weeks of the intention-focused treatment will yield more substantial results in the male population than if they had undergone the same amount of treatment as their female counterparts.

Summary and Conclusions

The current intervention-based study evaluated a preliminary treatment method for two participants experiencing effects from developmental stuttering that are impacting communication in their daily lives. Overall, results from the current novelistic stuttering treatment program of intention-focused training show the potential for being a feasible alternative to current evidenced based intervention. Due to the unknown effects on a larger sample size, as well as whether or not neural changes are being made through this intervention, the current study is fundamentally experimental, at best. Further research is warranted, as current evidence shows for this treatment. Moreover, if neural imaging becomes part of the protocol for pre- and post-treatment measurements, results may be evaluated in further detail.

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APPENDICES

APPENDIX A: IRB Letter of Determination

UNIVERSITY OF SOUTH FLORIDA

RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799
(813) 974-5638 • FAX (813) 974-7091

8/7/2015

Nathan Maxfield, PhD
Communication Sciences and Disorders
4202 East Fowler Avenue, PCD1017
Tampa, FL 33620

RE: **Expedited Approval for Initial Review**
IRB#: Pro00022328
Title: A Phase-1 Investigation of Right-Brain Intention Training in Adulthood Stuttering

Study Approval Period: 8/7/2015 to 8/7/2016

Dear Dr. Maxfield:

On 8/7/2015, the Institutional Review Board (IRB) reviewed and **APPROVED** the above application and all documents contained within, including those outlined below.

Approved Item(s):
Protocol Document(s):
Protocol

Consent/Assent Document(s)*:
Informed Consent_Aim1.pdf
Informed Consent_Aim2.pdf
Prescreening Interview **granted a waiver

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent document(s) are only valid during the approval period indicated at the top of the form(s). **Waivers are not stamped.

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR 56.110. The research proposed in this study is categorized under the following expedited review category:

(4) Collection of data through noninvasive procedures (not involving general anesthesia or sedation) routinely employed in clinical practice, excluding procedures involving x-rays or microwaves. Where medical devices are employed, they must be cleared/approved for marketing.

(6) Collection of data from voice, video, digital, or image recordings made for research purposes.

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

The screening portion of your study qualifies for a waiver of the requirements for the documentation of informed consent as outlined in the federal regulations at 45CFR46.117(c) which states that an IRB may waive the requirement for the investigator to obtain a signed consent form for some or all subjects if it finds either: (1) That the only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting from a breach of confidentiality. Each subject will be asked whether the subject wants documentation linking the subject with the research, and the subject's wishes will govern; or (2) That the research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside of the research context.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval via an amendment. Additionally, all unanticipated problems must be reported to the USF IRB within five (5) calendar days.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

John A. Schinka, Ph.D.

John Schinka, Ph.D., Chairperson
USF Institutional Review Board