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Effects of a Novel Right Brain Intervention on Stuttering Frequency in Unfamiliar Speech Tasks

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Effects of a Novel Right Brain Intervention on Stuttering Frequency in Unfamiliar Speech Tasks

by

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Developmental stuttering persists in approximately 1% of the United States population. Stuttering has been shown to impact overall quality of life. The present study examines the effects of a Novel Right Brain Intervention on two female participants with persistent developmental stuttering. The aim of the study was to determine whether encouraging greater activation of the right hemisphere, specifically the pre-SMA, via complex left-handed movements, prior to speech production, would lead to a reduced stuttering frequency and severity in people who stutter (PWS). It was hypothesized that each participant would reduce stuttering symptoms and behaviors following the intervention due to the results found in patients with non-fluent aphasia's and neural imaging findings with PWS. Following analysis of speech samples taken from unstructured retell and unfamiliar reading tasks, the results revealed decreases in stuttering and secondary behaviors during the unstructured reading task for Participant 1 and decreases in stuttering and secondary behaviors during the unstructured retell task for Participant 2. The results of this study should be interpreted with caution, as this is a pilot study with multiple limitations. With further research, this method of intervention may become a viable option for those who have not benefited maximally from current intervention methods.

INTRODUCTION

Developmental stuttering persists in about 2 million adults in the United States (Yairi & Ambrose, 2013), or 1% of the population (Yairi, 2005). According to the Centers for Disease Control and Prevention, approximately 1 in 68 children born in the United States will be diagnosed with an Autism Spectrum Disorder (Baio, 2014). The incidence of stuttering, or how many people have stuttered at some point in their life is approximately 5% (Yairi, 2005). Simply put, this means that about the same amount of people diagnosed with Autism are diagnosed with Developmental Stuttering each year, Stuttering can negatively impact a person's quality of life (QOL) in the domains for vitality, social functioning, emotional functioning, and mental health (Craig et al., 2009). People Who Stutter (PWS) tend to exhibit heightened levels of anxiety and depression, have lower social and emotional functioning, and struggle with relationship and career opportunities (Craig et al., 2002; Craig et al., 2009; Bray et al., 2003; Van Borsel et al., 2011, Bricker-Katz, et al., 2013). The impacts that stuttering has on a person's QOL have been related to neurotrauma such as Tetraplegia or Traumatic Brain Injury (TBI) on mental health QOL (Middleton et al., 2007), and coronary disease on mental health, emotional functioning, social functioning, and vitality (Lalonde et al., 2001). Research shows that many people who stutter have even considered suicide at some point in their lives. W. J. Ketley (1876) once said, "…the suffering caused to the stammering child is an ever-present torment that so gnaws into the soul that in many recorded cases it has in later life driven its victims to suicide."

Current therapy methods for those with persistent developmental stuttering include stuttering modification (Eichstadt, Watt, & Girson, 1998; Yairi & Sheery, 2015) and fluency shaping (Yairi & Sheery, 2015). Both stuttering modification and fluency shaping have been shown to produce tremendous gains but must be done intensively (Andrews & Ingham, 1972; Boberg, 1976; Helps & Dalton, 1979; Hasbrouck et al., 1985; Webster, 1974) with a significant amount of maintenance and self-management/ self-discipline following (Eichstadt, Watt, & Girson, 1998). Due to the amount of maintenance and self-management needed to maintain gains made during intensive therapy, relapse is common and almost unavoidable (McClure & Yaruss, 2003; Eichstadt, Watt, & Girson, 1998; Yairi & Sheery, 2015).

There has been a long held aim to use neural imaging results to shape new interventions (Ingham et al., 2004; Kell, 2012). Functional neural imaging (fMRI) research shows that the brain functioning during speech production differs between PWS and their non-stuttering peers (Brown et al., 2005). Further, PWS show different brain patterns when speaking fluently versus when experiencing stuttering, specifically an overactivation of the right hemisphere while speaking fluently and while stuttering with an underactivation of the left hemisphere while producing fluent speech (Belyk, Kraft, & Brown, 2014). The aim of this study is to investigate whether encouraging more activation of the right hemisphere prior to speech production, thus attempting to lateralize the motor planning and execution to the right hemisphere, will reduce stuttering frequency and severity in adults with persistent developmental stuttering.

The following sections will review the Epidemiology of Stuttering, Quality of Life Impacts, Current Interventions for People Who Stutter, Neural Imaging Correlates of

Fluent Speech in People Who Stutter, and finally, a Neural-Imaging Driven Anomia Intervention.

Epidemiology of Stuttering

Stuttering can be defined as a disorder that disrupts, or stops, the “forward flow” of speech, in which the individual knows what he or she wishes to say, but at the same time is unable to say it because of an involuntary, repetitive prolongation or cessation of sound (Andrews et al., 1983). Stuttering can include: repetitions of entire syllables, parts of syllables, or entire phrases; avoidance or substitutions of words; and prolongations/blocks that are either audible or silent (Bajaj et al., 2014; Craig, Hancock, Chang, et al., 1996; Craig, Hancock, & Chang, 1996). Most PWS also exhibit secondary behaviors such as gross body movements, eye blinks, lip or facial tremors, abnormal breathing, and fist clenching (Bajaj et al., 2014). Non-hispanic blacks and males are at a greater risk of developmental stuttering, about double the prevalence and a 4:1 ratio between men and women respectively (Yairi & Ambrose, 2013) but all people are susceptible to developing a fluency disorder.

The etiology of stuttering is unknown though a wide variety of theories attribute the etiology to a variety of factors. These include: linguistic deficits (Postma & Kolk, 1993; Howell, 2004), speech-specific motor deficits (Namasivayam & van Lieshout, 2011), anticipation of speech difficulties (Brockle-hurst et al., 2013), and/or disordered sensory feedback (Max et al., 2004). The one thing all theories have is common is the idea that there is a strong genetic influence behind stuttering (Kraft & Yairi, 2012).

Quality of Life Impacts

The World Health Organization (WHO; 2001) classifies health and health-related conditions based on functioning, disability, and health. This classification system is called the International Classification of Functioning, Disability, and Health (ICF). Further, WHO defines "health" as "the complete physical, mental, and social functioning of a person…" (2001). The WHO-ICF model goes beyond just the body functions and structures affected by a disease/disorder and identifies the "disablement and health-related consequences" of said disease/disorder by looking at three domains: impairment, activity limitations, and participation restrictions. The impairment is whatever is going "wrong" psychologically or anatomically - such as the actual act of stuttering. Activity limitations refer to a difficulty someone with the above identified impairment may have while doing certain tasks or "activities." An activity limitation for someone who stutters may including difficulty speaking on the telephone or giving a speech to a large crowd. Finally, participation restrictions refer to specific situations that the person with said impairment may avoid/be unable to involve themselves in due to their impairment and subsequent activity limitations (Rusch et al., 2004). For example, a person who stutters may avoid certain jobs and/or social situations due to their inability to speak without stuttering in said situations.

Patrick and Erickson (1993) defined quality of life (QOL) as being "a comprehensive construct that encompasses the emotional, mental and physical functioning, life satisfaction and overall well-being" (p. 377). Stuttering has been shown to have negative impacts on a person's quality of life in the domains of vitality, social functioning, emotional functioning, and mental health (Craig et al., 2009; Yaruss, 2010).

Nearly all PWS have some elevated level of anxiety and an increased risk of poor emotional functioning (Craig et al., 2002; Craig et al., 2009). Stuttering affects the PWS in regards to both activity limitations and participation restrictions. PWS are likely to experience negative emotions such as fear, depression, shame, embarrassment, and anger in regards to their speech that may lead to avoidance of conversation in different social situations such as social, occupational, and educational (Bajaj et al., 2014). The next sections will examine how stuttering can affect a PWS in regards to their mental health as well as their social and occupational well-being.

Mental Health Impacts

Generalized anxiety can be a major consequence of developmental stuttering in adults. Adults who have stuttered since childhood are likely to develop anxiety, which may play a role in amplifying the stuttering symptoms (Baker & Cantwell, 1987). Craig et al. (1984) found that PWS have a "higher locus of control" which means that they tend to believe that their life is controlled more so by luck/chance than by their own choices, actions, or abilities. This may lead to social anxiety, due to their feelings that they have no control over the situations that they place themselves in (Craig et al., 1984). In fact, most, if not all, PWS exhibit elevated levels of anxiety when compared to their non-stuttering peers (Craig, Hancock, et al., 2003). PWS have also been reported to have a lower self-efficacy than their non-stuttering peers, which has been linked to a higher percentage of depression (Bray, Kehle, Lawless, & Theodore, 2003).

Social Impacts

People who stutter have often reported QOL related difficulties with social interactions, perceived intelligence/ability to reach their potential educationally and occupationally, and perceived ability to complete activities of daily living (Craig, 2010; Craig et al., 2009; Klein & Hood, 2004; St. Louis, 2001; Yaruss & Quesal, 2006). PWS have been shown to view their speech as limiting when attempting to develop both friendly and romantic relationships due to the major role speech and communication play in forming these relationships (Daniels, 2007; Hayhow, Cray, & Enderby, 2002; Linn & Caruso, 1998).

These inter-personal impacts don't wait until adulthood to begin. Langevin (2009) found that almost one in five children thought negatively about children who stutter and Langevin et al. (1998) found that 59% of children who stuttered had been teased and/or bullied at least once in their life for their stuttering with 56% of these children experiencing bullying at least once a week. These acts of bullying can stay with a person for a long time. Hugh-Jones and Smith (1999) found that out of 276 adults who stuttered, 83% reported having been bullied during their school age years. These children may grow up to be adults who struggle with below average self-perceived competence in their communication abilities, fear and uneasiness of speaking in certain situations, and difficulties with acceptance of stuttering (Erickson & Block, 2011). Both adolescents and young adults have reported that they perceive those who stutter as less attractive than their normally fluent peers and that they are less likely to initiate romantic relationships with those who stutter versus those who do not (Van Borsel et al., 2011). Further, 43.6% of PWS surveyed noted how stuttering did, in fact, have a negative influence both on their marital and familial lives (Klompas & Ross, 2004). These difficulties can place strain on the family as well as the person who stutters, with parent difficulties understanding their children's stutter and feeling as though they are 'to blame' for the difficulties their child has experienced (Hearne et al., 2008; Erickson & Block, 2011). Many adults who stutter have reported feeling as though their stutter had an effect on their relationship with their parents (Klompas & Ross, 2004).

Occupational Impacts

Approximately 62% of Americans make their living working jobs that depend on verbal communication skills (Klein & Hood, 2004). Unfortunately, one handicapping aspect of stuttering is the effect it may have on one's occupational life. Adults who stutter may make decisions on their career path based solely on their speaking abilities, or inabilities, may be left behind and/or discriminated against when applying for jobs or promotions due to negative attitudes of employers with regards to their speech, and may never be able to reach their occupational potential. In a survey of 232 people who stutter, Klein and Hood (2004) found that over 70% of PWS felt that their speech decreased their chances of being hired and/or promoted, over 33% felt that stuttering affected their job performance, and 20% had been turned down for a job or promotion due to their stuttering. While these facts simply present the feelings of PWS in regards to their occupational lives, a large study of employer attitudes conducted by Hurst and Cooper (1983) revealed that 30% of employers felt stuttering interferes with job performance, 40% would neglect to promote someone who stutters due to their speech, 44% felt that PWS should seek occupations that don't require much speaking, and 85%

felt that stuttering would impact whether or not they would hire someone. Further, only 9% of employers believed that they would hire someone who stutters when given an equal candidate who did not.

It is clear that stuttering can affect the employment opportunities of PWS, which can also impact their initial choice of career. Craig & Calver (1991) found that it is common for PWS to settle for jobs below their potential due to their lack of self-confidence and/or inability to be employed due to their speech. PWS tend to choose careers where using the telephone or giving presentations verbally is unnecessary and settle for jobs below their qualifications due to fear of rejection or negative attitudes of employers and co-workers (Hayhow, Cray, & Enderby, 2002; Gilmore, 1974). Silverman & Bongey (1997) found that nurses have judged physicians who stutter to be less competent and more anxious at their work than physicians who do not stutter, while Silverman & Paynter (1990) have found that college students have judged lawyers who stutter to be less intelligent and, therefore, less competent in their work than their non-stuttering peers. While these statements are obviously untrue, they can affect the way a person feels about themselves and, inevitably, change the course of their occupational lives.

Current Interventions for People Who Stutter

Current interventions for adults with persistent developmental stuttering include stuttering modification (Eichstadt, Watt, & Girson, 1998; Yairi & Sheery, 2015) and fluency shaping (Yairi & Sheery, 2015). The aim of stuttering modification is to produce “more fluent stuttering” (Yairi & Sheery, 2015) by having the PWS accept responsibility for both their speech and for modifying their speech; reducing avoidances and fears; improving self-confidence; and increasing their knowledge of the disorder (Eichstadt, Watt, & Gibson, 1998). The first step of stuttering modification is to identify and reduce any secondary behaviors that the PWS may be using in order to create a "clean" stutter (Eichstadt, Watt, & Gibson, 1998). PWS then learn different modifications that allow them to identify the incorrect positioning of the larynx and articulators and then modify this positioning in order to create more fluent speech. These modifications include the post-block correction, in-block correction, and pre-block correction (Yairi & Sheery, 2015).

The goal of fluency shaping is to encourage more smooth speech by use of slow transitions, easy onset of voicing, gentle contacts of the articulators, shorter phrases, and connection of words within phrases. In order to achieve this smoother speech, the person must begin by speaking in a "novel but totally fluent manner" by elongating vowels and/or syllables to produce a slower rate while using gentle breathing, articulation, and vocalization techniques (Yairi & Sheery, 2015). Once the speech is totally fluent, the PWS will begin "shaping" their speech in order to sound more natural. This includes introducing normal prosodic parameters, intonation, stress, and rhythm back into their smooth speech while continuing using slow transitions, easy onset, gentle contacts, etc. (Yairi & Sheery, 2015).

As mentioned earlier, both stuttering modification and fluency shaping have been shown to produce remarkable results, but must be done intensively (Andrews & Ingham, 1972; Boberg, 1976; Helps & Dalton, 1979; Hasbrouck et al., 1985; Webster, 1974) and must be followed up with a significant amount of maintenance (Boberg, 1976; Helps &

Dalton, 1979; Hasbrouck et al., 1985; Webster, 1974) in order to avoid relapse. Due to the amount of self-discipline it requires to maintain the progress made during intervention, and the difficulties generalizing modifications learned, relapse is common occurrence (McClure & Yaruss, 2003; Eichstadt, Watt, & Girson, 1998; Yairi & Sheery, 2015; Craig & Calver, 1991; Onslow & Ingham, 1987). Relapse, unfortunately, has been shown to raise the levels of trait anxiety when compared to those who do not relapse (Craig, 1998). Further, these therapy methods, due to their behavioral nature, do not produce the same results in all people (Huinck, 2005), and those who do achieve a more fluent speech pattern may find that their speech is now very ‘unnatural’ or ‘managed’ sounding, which can result in a greater risk for relapse due to societal expectations for them to use faster, less managed sounding speech (Onslow & Ingham, 1987). Relapse, of course, is determinant on multiple factors that affect each person individually, as all behavioral treatments like these are (Craig, 1998).

Neural Imaging Correlates of Fluent Speech in People Who Stutter

Neural imaging has long shown evidence that the brain functions differently during speech production in PWS and people who do not stutter. Specifically, three ‘neural signatures of stuttering’ have been identified. These are: over activation in the right frontal operculum, anterior insula, and in the vermal region of lobule III of the cerebellum, and absence of activation in the auditory areas bilaterally (Brown et al., 2005).

More recently, functional neural imaging has revealed that PWS not only show different brain patterns during speech than their non-stuttering peers but that they also may show different brain patterns when speaking fluently versus when experiencing stuttering (Belyk, Kraft, & Brown, 2014). There seems to be an over activation of the right hemisphere during both fluent and stuttered speech in PWS, with a concurrent under activation of the left hemisphere during fluent, or non-stuttered, speech (Belyk, Kraft, & Brown, 2014; Brown et al., 2005; Ingham et al., 2012). These findings suggest a possibly compensatory role of the right hemisphere in producing fluent speech in adults who stutter. This same compensatory role of the right hemisphere is suspected in persistent non-fluent aphasia (Nadeau & Crosson, 1997).

A Neural-Imaging driven Anomia Intervention

Research shows that the right-hemisphere of the brain plays a large role in language production in chronic fluent aphasia patients following a left-hemisphere lesion (Basso et al., 1989). Therefore, Crosson and colleagues determined that consideration must be given to encouraging right-hemisphere participation in speech production rehabilitation for these patients (Crosson et al., 2007). Bruce Crosson and colleagues (2007, 2008, 2014) developed an intervention designed to recruit right-hemisphere involvement via intention and attention mechanisms prior to speech production in patients with non-fluent aphasia.

Intention can be defined as the “ability to select one among several competing actions for execution and initiation of that action” (Crosson et al., 2007) while attention can be defined as the “ability to select one source of information among multiple competing sources for further processing” (Crosson et al., 2007). Because the Intention intervention produced longer lasting and better generalizing results (Crosson et al., 2007), the current study will only be looking at this intervention.

Imaging studies have indicated that the pre-SMA, which is involved in complex hand movements, overlap with the regions of the brain involved in word generation. Using complex left handed movements to “prime” the right pre-SMA during word generation led to an increased ability to name pictures shown on a computer screen (Crosson et al., 2003). The intention intervention involved using a non-symbolic left-handed movement to initiate a picture-naming trial. The idea behind this intervention was that by using the left-hand to activate intention mechanisms in the right pre-SMA, the language production processes in the brain would be lateralized to the right frontal cortex (or at least the efficiency of the right frontal cortex would be improved) and word generation would be improved.

Crosson and colleagues (2007) found that 89% of the patients with moderate to severe word-finding impairments exhibited significant improvement and 85% showed generalization, while 55% of the patients with profound word-finding impairments exhibited significant improvement following the intention intervention.

If there is a compensatory role of the right hemisphere in producing fluent speech in adults who stutter, there is reason to believe that this intention therapy developed by Crosson and colleagues (2007, 2008, 2014) may result in more fluent speech in this population. The aim of this study is to investigate whether encouraging more activation of the right hemisphere prior to speech production, thus lateralizing the motor planning and execution to the right hemisphere, will reduce stuttering frequency and severity in adults with persistent developmental stuttering.

Emphasis on Unstructured and Unfamiliar Speech Modes

There is a range of ways to look at fluency and the speech of PWS. This paper will examine the effects of the Novel Intention Treatment on the fluency of each participant during an unfamiliar reading task and an unstructured retell.

Unfamiliar reading tasks were chosen to examine the effects of this novel treatment in the absence of any learning, or practice, effects, a phenomenon experienced by many PWS when reading familiar transcripts on multiple occasions over a period of time that allows them to perform the task with less stuttering behaviors over time due to motor learning (Max & Baldwin, 2010). Unfamiliar reading tasks are more common in daily living than familiar reading tasks, thus the data obtained from this task provides information about generalization and functionality of the treatment effects.

The unstructured retell task was chosen to examine the effects of the Intention Treatment due to the functionality and generalization of the task. Unstructured monologues are arguably the most difficult speaking mode. The speaker must formulate ideas, make them into words, and put them into speech. This mode creates the highest workload and demand on the brain. Conversing in daily life is often spontaneous and ambiguous, rather than scripted. Using a task that allowed the participants to develop and formulate their own story line/thought provided the study with data that will more readily generalize to the daily lives of the participants.

Summary and Research Aims

Being able to communicate effectively is vital in regards to a person's mental health, social acceptance, and occupational opportunity (Iverach et al., 2009). Those with developmental stuttering do not always have this ability. This inability to produce a forward flow of speech without interruption can lead to mental health difficulties such as anxiety and depression stemming from fear and disapproval from peers, inability to create lasting meaningful relationships, both socially and romantically, and missed opportunities to advance in careers due to unfair discrimination and negative attitudes from employers (Craig et al., 1984; Craig, Hancock, et al., 2003; Bray, Kehle, Lawless, & Theodore, 2003; Langevin et al., 2009; Silverman & Bongey, 1997; Silverman & Paynter, 1990; Daniels, 2007; Hayhow, Cray, & Enderby, 2002; Linn & Caruso, 1998; Hurst & Cooper, 1983). Current treatment methods have been proven to produce results when done intensively (Andrews & Ingham, 1972; Boberg, 1976; Helps & Dalton, 1979; Hasbrouck et al., 1985; Webster, 1974) and paired with an enormous amount of maintenance, resulting in an unnecessary amount of relapse and further anxiety for the PWS (McClure & Yaruss, 2003; Eichstadt, Watt, & Girson, 1998; Yairi & Sheery, 2015; Craig & Calver, 1991; Onslow & Ingham, 1987; Craig, 1998). Examination of the efficacy of current stuttering treatments, i.e., stuttering modification, has shown positive results immediately following treatment, with an increase towards baseline of stuttering behaviors two years later (Eichstadt, Watt, & Girson, 1998). The reasoning behind these relapse rates is the “enormous amount of self-discipline, determination, and energy” required to monitor ones speech and maintain fluency (Eichstadt, Watt, & Girson, 1998). Further, in a survey of National Stuttering Association members (n=710 respondents), only 30% found stuttering modification therapies to be successful while 19% found fluency shaping therapies to be successful (McClure & Yaruss, 2003). With high relapse rates and low success rates, as reported by members of the National

Stuttering Association, a line of research has been concerned with finding new interventions for stuttering (Franklin et al., 2008), some specifically interested in using functional neural imaging results to inform new methods of intervention.

Recent functional neural imaging has shown differences in brain patterns in PWS when producing fluent speech when compared to stuttered speech (Belyk, Kraft, & Brown, 2014). Said imaging has shown a possible compensatory nature of the right-hemisphere of the brain when producing fluent speech that can be compared to the compensatory nature of that seen in people with chronic nonfluent aphasia (Belyk, Kraft, & Brown, 2014; Brown et al., 2005; Ingham et al., 2012; Nadeau & Crosson, 1997). Bruce Crosson and colleagues have developed an Intention Treatment that has shown positive results in increasing word generation in those with chronic nonfluent aphasia, thus encouraging the right-hemisphere to compensate for the left-hemisphere when planning and executing speech (Crosson et al., 2007). The aim of this study is to investigate whether encouraging more activation of the right hemisphere prior to speech production, thus attempting to lateralize the motor planning and execution to the right hemisphere, will reduce stuttering frequency and severity in adults with persistent developmental stuttering. More specifically, will the Intention intervention reduce the frequency of stuttering behaviors in Unfamiliar Reading and Unstructured Retell? The hypothesis is that Due to the compensatory role of the right hemisphere in both production of fluent speech in AWS and in Non-Fluent Aphasia and the positive effects found by Crosson and colleagues (2007), stuttering severity will decrease following the Intention treatment.

METHODS

Participants

Intervention was conducted with two female participants with developmental stuttering present since childhood. Participant 1 is left-handed, bilingual (Spanish and English), and received group speech therapy services targeting stuttering from kindergarten to twelfth grade in public school. During the study, she was a full-time undergraduate college student. Participant 1 often made mention of unanticipated stressors occurring in her daily life throughout the duration of intervention, which may have had an effect on her stuttering. She struggles with mild anxiety and hypersensitivity to listeners' reactions, and tends to switch words while speaking in order to avoid moments of disfluency. Participant 2 is a right-handed, monolingual English speaking, full-time undergraduate college student. From kindergarten through fifth grade, she received speech therapy services through her public school targeting articulation, with little emphasis on stuttering modification or fluency shaping. Throughout the duration of the intervention, Participant 2 often revealed instances of lack of sleep due to a demanding school schedule, as well as mild social anxiety which, as stated by the participant, coincided with moments of stuttering.

Treatment

The treatment methods used in the present study followed closely with the work completed by Bruce Crosson and colleagues in 2007. Crosson et al. (2007) administered two separate treatments, each with three phases: Intention and Attention Treatments. The present study looks at the effects of only the Intention Treatment on AWS. Closely following the Intention Treatment administered to participants with Anomic Aphasia (Crosson et al., 2007), each participant received three weeks of intensive right-brain training. The treatment involved using complex left-handed movements to initiate picture-naming trials. Complex left-handed movements were used to stimulate the pre-SMA in the right hemisphere, an area of the brain involved in word generation (Crosson et al., 2007), in an attempt to encourage more activation of the right hemisphere prior to speech production and, thus, lateralize the motor planning and execution to the right hemisphere.

The treatment was administered over the course of three weeks, each week differing slightly in protocol. In the study conducted by Crosson and colleagues (2007), ideally participants were administered one 45-minute session per day/5 times per week, and each phase lasted two weeks. Some patients in their study were unable to attend 5 days out of the week and were provided with two sessions per day, with 30 minutes elapsing between treatments. In the present study, the treatment phase lasted 3 weeks, each week changing slightly in protocol. Participants were administered two 30-minute treatments per day, with 30 minutes elapsing between treatments. Participant 1 received 10-treatment sessions per week for a total of 15 hours of intervention, and Participant 2 received 6-treatment sessions per week due to schedule conflicts and an inability to participate more than 3 days/week, for a total of 9 hours of intervention. A schedule of treatment and measures can be referred to in Table 1.

Treatment procedures for the present study were conducted in a dimly-lit, sound-attenuating booth, where participants faced a 23-inch computer monitor situated at eye level for the duration of each 30-minute trial. Throughout each trial, the attending therapist 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 setup 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 attending therapist regarding procedures to follow throughout the duration of each task of 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 Treatment Phase Week 1, the participant and therapist sat in the sound-attenuating booth with the box placed slightly in front and to the participant's left. The therapist initiated the first trial by pressing the spacebar on the computer outside of the sound-attenuating booth prior to joining the participant in the booth. A 60 font single asterisk, or star, appeared on the screen and after 5 seconds, a 1000 Hz tone would sound. When the participant heard the tone, using their left hand, they would open the box, place the lid off to the side, reach into the box, and press any button within the box. 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 therapist would place the lid back onto the box and click the mouse to advance to the next item. Once the therapist clicked the mouse, a new star would immediately appear on the monitor. If the participant had a moment of disfluency while naming the picture, the therapist 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 Treatment Phase Week 2, the participant and therapist were seated the same as in Treatment Phase Week 1 and the box was in the same location. The therapist initiated the first trial by pressing the spacebar on the computer outside of the sound-attenuating booth prior to joining the participant in the booth. During week 2, the tone that accompanied the star was eliminated and there was a two second delay added between the participant pressing a button within the box and the line drawing appearing on the screen. When the participant saw the star, using their left hand, they would open the box, place the lid to the side, reach into the box, and press any button within the box. After pressing a button, the star would disappear, and after two seconds, a black and white line drawing would appear on the monitor. The participant would then name the picture. Again, if the participant named the picture fluently, the therapist would reset the box and initiate the next trial. If the participant was disfluent while naming the picture, the therapist would model the same non-meaningful circular left-hand movement while saying the word. The participant would repeat the correct picture name while making the left-handed movement three times. Following a fluent naming of the picture, the therapist would then begin the next trial.

During Treatment Phase Week 3, the box was removed as well as the initial tone. The therapist initiated the first trial by pressing the spacebar on the computer outside of the sound-attenuating booth prior to joining the participant in the booth. A star would then appear on the computer monitor. When the star appeared, the participant would then perform the same non-meaningful circular left-hand gesture, as mentioned above, three times. Once the participant had completed their left-handed gesture, the therapist 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 then name the picture shown. If the participant fluently named the picture, the therapist would initiate the next trial by clicking the mouse and bringing a star onto the screen. If the participant was disfluent while naming the picture, the therapist would model the same non-meaningful circular left-hand movement while saying the word. The participant would repeat the correct picture name while making the left-handed movement three times. Following a fluent naming of the picture, the therapist would then begin the next trial.

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 International Picture Naming Project (IPNP; Szekely et al., 2004). Presentation content was randomly organized, ensuring variability and nonconformity among presentations. Each presentation correlated with a single session, and participants were instructed to dedicate five minutes to each session. The maintenance program was split up into three 2-week segments. Weeks 1 and 2 post-treatment consisted of the participant completing five sessions throughout each week on five separate days, weeks 3 and 4 post-treatment, consisted of the participant completing three sessions throughout each week on three separate day, and weeks 5 and 6 post-treatment 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 initiate a maintenance session. Participants were instructed to sit in front of the computer screen as they did in the sound-attenuating box during treatment, and to use their left hand to make two circular gestures before naming the object or action out loud. To advance to the next picture, they were to click their mouse or spacebar with their left hand. Specific instruction was given to participants to not use their right hand for any purpose. If the presentation had ended before five minutes had passed, the participants were instructed to simply begin the same presentation again. Participants were encouraged to fill out a provided maintenance log, shared on a Google Document with the therapists. On the maintenance log, the participants shared the dates when maintenance sessions were completed, as well as any instances of events or stressors that may have affected their fluency that week. The maintenance log served as a tracking tool for the therapists to keep watch over a participant's attendance to the task, as well as an instrument of encouragement for participants to complete the tasks independently. Participants were emailed at the beginning of each week with the PowerPoints they would use for the week. Weeks 1 and 2 consisted of five presentations per week, weeks 3 and 4 consisted of three presentations each, and weeks 5 and 6 contained one presentation per week.

Table 1. Participant Schedule of Treatment and Measures

	Pre-Intervention Phase	Treatment Phase			Maintenance Phase			Follow Up Measures
Intervention	No intervention	Week 1	Week 2	Week 3	Weeks 1 & 2	Weeks 3 & 4	Weeks 5 & 6	No intervention
Measures Obtained	Baseline speech samples: two retell, two reading	Speech samples: two retell, two reading	Speech samples: two retell, two reading	Post-Intervention speech samples: four retell, four reading	No measures	No measures	No measures	Follow-Up speech samples: four retell, four reading

Stimuli

Prior to treatment, participants were primed for the intervention by completing a naming task consisting of black and white line picture stimuli representing 160 common objects and 160 transitive and intransitive actions, selected from the IPNP (Szekely et al., 2004). The objects and actions used during priming were included in the total number of 520 common objects and 275 transitive and intransitive actions used throughout each week of intervention, as well as maintenance. The 795 black and white line drawings were 300 x 300 pixels each, and were displayed in the center of the computer screen upon presentation. Additional stimuli included a 1000 Hz tone utilized during Treatment Phase Week 1, which occasionally accompanied a size 60, Arial font asterisk, commonly referred to as a "star" throughout intervention. Each week of intervention was conducted using Eprime software, Version 1.1 (Psychology Software Tools, Sharpsburg, PA).

Measures

Unlike Crosson and colleagues' study, the present research examined the fluency of speech of each participant in four domains: unfamiliar reading, familiar reading, unstructured retell, and structured retell. Although this paper will examine the effects of the Novel Intention Treatment on the fluency of each participant during only the unfamiliar reading task and the unstructured retell, speech samples within each domain were obtained at baseline measures, upon conclusion of each week during the treatment phase, and at follow up measures, which were obtained seven weeks post-treatment. Samples were obtained by filming the participant during each reading and retell task. Analysis of each sample was completed offline at a later date.

Unfamiliar reading transcripts were taken from *Dynamic Indicators of Basic Early Literacy Skills* (DIBELS), 6th Edition, Oral Reading Fluency Progress Monitoring Sixth Grade Student Materials (Good & Kaminski, 2007). The unfamiliar reading transcripts were specifically chosen to be appropriate for a sixth-grade reading level, ensuring ease of readability for the participants. To ensure both unfamiliarity and no opportunity for a learning effect, each measure obtained used a different DIBELS passage.

For the unstructured retell task, participants watched approximately 15 minutes of “Koyaanisqatsi: Life Out of Balance” (1983), a film produced in montage style, with no apparent structured storyline, placing a burden of uncertainty upon the viewer when attempting to develop a solid idea about what the film is intended to portray. The purpose of using this style of film for unstructured retell was to provoke a response from the participant that was purely spontaneous, arising from ambiguity.

Baseline measures were obtained on three separate occasions prior to the beginning of treatment. Participant 1 provided speech samples on Monday, Wednesday, and Friday, starting two weeks prior to initiation of treatment week 1, while Participant 2 provided speech samples on Monday, Tuesday, and Wednesday, during the week prior to initiation of Treatment Phase Week 1. During the treatment, weekly measures were obtained from Participant 1 on Fridays and from Participant 2 on Wednesdays, immediately following the final treatment session of the week. For the purposes of this study, only the baseline, post-intervention (end of week 3), and follow-up measures were coded for stuttering symptoms and behaviors.

Each participant was provided with specific instructions before each sample was obtained, thoroughly explaining what was expected of them. Prior to the unfamiliar reading task, the participants were handed a transcript to be read aloud upon prompting. They were asked to look through each transcript and identify any words that were unfamiliar to them or that were difficult to pronounce. This was done to ensure that inability to decode a word was not a factor in their fluency. They were then asked to read each transcript as naturally as possible, given specific instructions to not use any therapy methods previously learned. Prior to the unstructured retell task, each participant watched a predetermined length of the accompanying film on a laptop computer positioned directly in front of them. Before obtaining a speech sample following the segment of film, each participant was instructed to speak for approximately five minutes about what they had just watched, what they thought it meant, and what they think may happen in the next segment, using as much detail as possible. If the participants were unable to speak for five minutes about the film, the therapist would probe them with simple open-ended questions to continue the dialogue. Participants were again reminded to speak as naturally as possible, ensuring that they did not use any therapy methods previously learned.

Post-treatment measures were recorded on the closing day of Treatment Phase Week 3, immediately following the cessation treatment. Supplementary to the four domains of speech measured weekly, four additional speech samples were obtained during these post-treatment measures as well as during follow-up measures. The supplementary speech samples consisted of the four domains previously mentioned, along with the addition of a left-handed circular gesture based upon Treatment Phase Week 3 protocol to be implemented during the first word of each phrase. For each of the retell samples, an additional 10-15 minutes of the film was provided for additional speaking material, with time of play accordingly adjusted by the therapist to ensure ample content for monologue. For the unfamiliar reading passage during the gesture-accompanied task, a new reading passage was provided.

Each speech sample taken was transcribed offline at a later date. For the unfamiliar and familiar readings, the middle 100 words were transcribed and coded for stuttering symptoms. For the unstructured and structured retells, 100 words were taken

30 seconds into each sample. In rare occasions, the therapist was prompting the participant at this time. If this were to happen, the therapist scoring used best judgement to find a starting point where the participant was not being prompted and was again speaking freely. These occasions will be noted below in the results. Once transcribed, the samples were coded for stuttering symptoms based on the Lidcombe Behavioral Data Language of Stuttering (LBDL; Teesson, Packman, & Onslow, 2003). The stuttering behaviors identified were as follows: syllable repetition, incomplete syllable repetition, multisyllabic unit repetition, fixed posture with audible airflow, fixed posture without audible airflow, superfluous verbal behaviors, and superfluous nonverbal behavior (Teesson, Packman, & Onslow, 2003). In the present study, the use of substitution during reading passages was also noted as well as when multiple stuttering behaviors were used in conjunction (transcribed as "mixed"). Examples of each behavior and coding protocol is shown below in Table 2 .

Table 2. Stuttering Behaviors Coding System

Descriptor	Examples of Corresponding Behavior	Code
Syllable repetition	"where...where...where's the ball?"	"where...where...where's the ball"
Incomplete syllable repetition	"I went to S...S...Sydney…"	"I went to S ...S...Sydney
Multisyllable unit repetition	"it' a...it's a...it's a great…" "what a great oppor...oppor...tunity" "swimming...swimming"	multisyllable unit repeated
Fixed posture with audible airflow	"mmmmmy one" "ffffffishy gone!"	* (*my/ *fishy)
Fixed posture without audible airflow	"I…..(no sound) bought…" (Sounds kind of forced out)	__ "I __ bought"
Superfluous verbal behaviors	"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)
Mixed	Mix of any of the above stuttering behaviors - indicated with which two or more behaviors were used	Highlight
Substitution of word (During Reading Passage)	Word expected: may Word said: will	STRIKE THROUGH may (will)

Reliability

Interrater agreement reliability was calculated by comparing the coding sheets of the experimenter with those of another trained clinician. The other clinician was trained on how to code for stuttering symptoms and secondary behaviors and provided with the same system shown in Table 2. One sample from each speaker and task, for a total of 8 samples, was scored using the same coding system. Reliability was found to be within 80% and 100% for each sample, with an average of 96% agreement.

RESULTS

Individual Results

In the unfamiliar reading task, participant 1 exhibited an average of 16 stuttering symptoms and behaviors at baseline. Post-treatment, she exhibited 10 stuttering symptoms and behaviors without the accompanying left handed movement, and 5 stuttering symptoms and behaviors when using the accompanied left handed movement. At follow up, participant 1 displayed 4 stuttering symptoms and behaviors without the accompanying left handed movement, and 7 stuttering symptoms and behaviors when using the accompanied left handed movement. These results are shown in Figure 1.

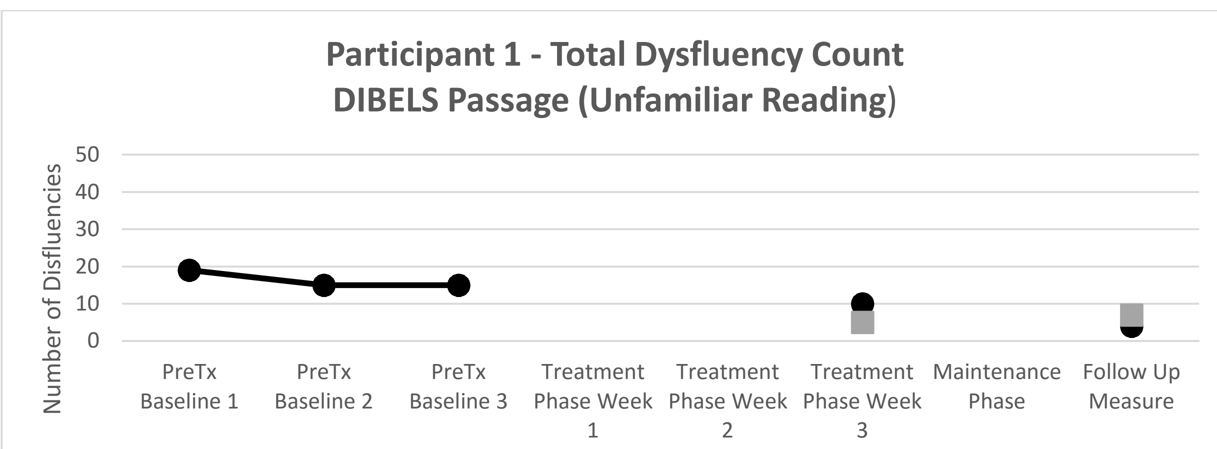

Figure 1. Number of total disfluencies in 100 word speech sample for Participant 1: Unfamiliar Reading. Samples were not scored during treatment weeks 1 & 2. Square markers indicate disfluencies when speech was accompanied by the left hand movement.

During an unstructured retell task, participant 1 exhibited an average of 15 stuttering symptoms and behaviors at baseline. Post-treatment, she exhibited 14 stuttering symptoms and behaviors without the accompanying left handed movement, and 12 stuttering symptoms and behaviors when using the accompanied left handed movement. At follow up, participant 1 displayed 16 stuttering symptoms and behaviors without the accompanying left handed movement, and 9 stuttering symptoms and behaviors when using the accompanied left handed movement. These results are shown in Figure 2.

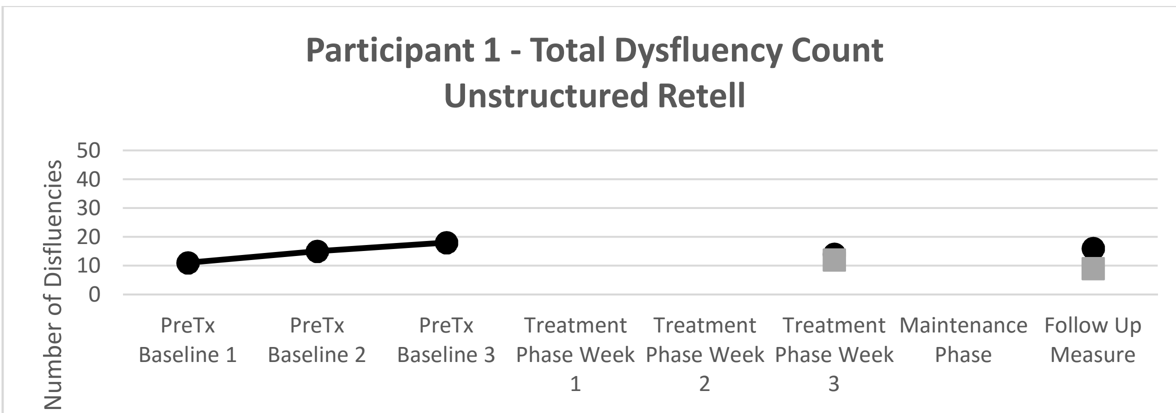

Figure 2. Number of total disfluencies in 100 word speech sample for Participant 1: Unstructured Retell. Samples were not scored during treatment weeks 1 & 2. Square markers indicate disfluencies when speech was accompanied by the left hand movement.

In the unfamiliar reading task, participant 2 exhibited an average of 11 stuttering symptoms and behaviors at baseline. Post-treatment, she exhibited 9 stuttering symptoms and behaviors without the accompanying left handed movement, and 4 stuttering symptoms and behaviors when using the accompanied left handed movement. At follow up, participant 2 displayed 11 stuttering symptoms and behaviors without the accompanying left handed movement, and 12 stuttering symptoms and behaviors when using the accompanied left handed movement. These results are shown in Figure 3.

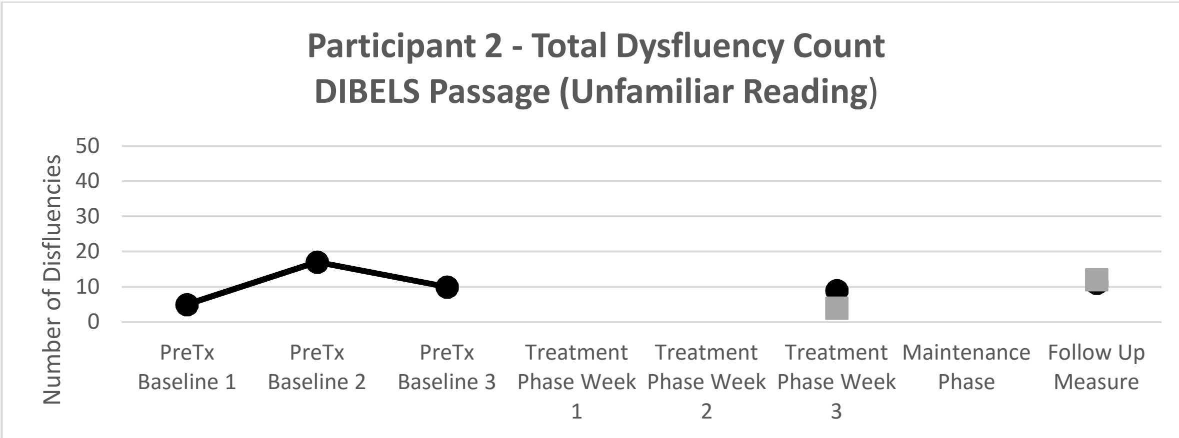

Figure 3. Number of total disfluencies in 100 word speech sample for Participant 2: Unfamiliar Reading. Samples were not scored during treatment weeks 1 & 2. Square markers indicate disfluencies when speech was accompanied by the left hand movement.

During an unstructured video retell, participant 2 exhibited an average of 38 stuttering symptoms and behaviors at baseline. Post-treatment, she exhibited 20 stuttering symptoms and behaviors without the accompanying left handed movement, and 21 stuttering symptoms and behaviors when using the accompanied left handed movement. At follow up, participant 2 displayed 16 stuttering symptoms and behaviors without the accompanying left handed movement, and 22 stuttering symptoms and behaviors when using the accompanied left handed movement. These results are shown in Figure 4.

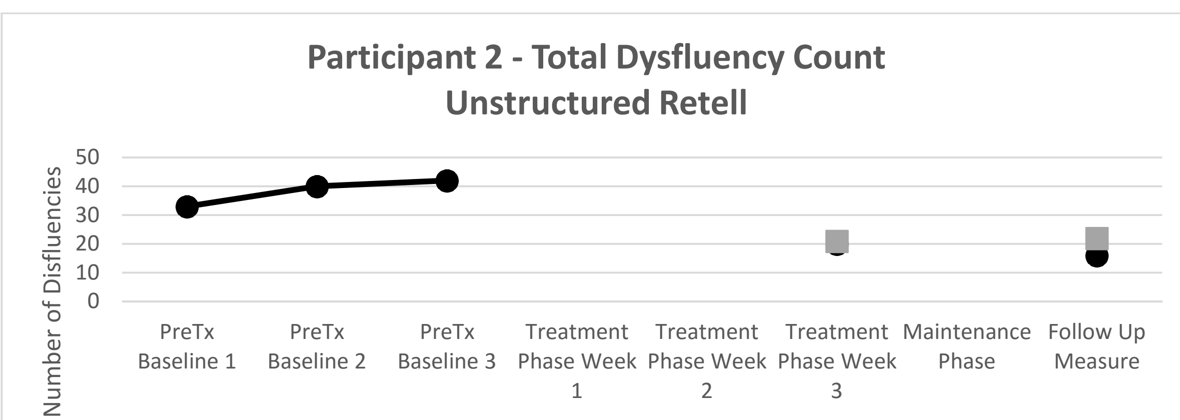

Figure 4. Number of total disfluencies in 100 word speech sample for Participant 2: Unstructured Retell. Samples were not scored during treatment weeks 1 & 2. Square markers indicate disfluencies when speech was accompanied by the left hand movement.

DISCUSSION

Summary

Developmental stuttering persists in nearly 2 million adults in the United States (Yairi & Ambrose, 201). Stuttering has been shown to impact the sufferer's overall quality of life (Iverach et al., 2009; Craig et al., 1984; Craig, Hancock, et al., 2002; Bray, Kehle, Lawless, & Theodore, 2003; Langevin et al., 2009; Silverman & Bongey, 1997; Silverman & Paynter, 1990; Daniels, 2007; Hayhow, Cray, & Enderby, 2002; Linn & Caruso, 1998; Hurst & Cooper, 1983). Current treatment methods have shown positive results when provided intensively (Andrews & Ingham, 1972; Boberg, 1976; Helps & Dalton, 1979; Hasbrouck et al., 1985; Webster, 1974). These methods have shown positive results, however longevity tends to be affected on self-management and maintenance. (Eichstadt, Watt, & Girson, 1998). Due to these findings, a line of research has been concerned with using functional neural imaging results to inform new intervention methods for stuttering (Franklin et al., 2008), which has found differences in brain patterns both between PWS and NFA as well as between PWS when fluent and when in the state of stuttering (Belyk, Kraft, & Brown, 2014; Brown et al., 2005; Ingham et al., 2012). Bruce Crosson and colleagues (2007), have developed an Intention Treatment aimed at improving word generation in those with chronic non-fluent aphasia that encourages the right-hemisphere to compensate for the left-hemisphere when planning and executing speech production (Crosson et al., 2007). In the present study, two female participants with persistent developmental stuttering received this Novel

Intention Treatment (2007), in order to determine whether encouraging more activation of the right-hemisphere prior to speech production in PWS would reduce stuttering frequency and severity in adults with persistent developmental stuttering.

Each participant received only the Intention Treatment (2007). Treatment consisted of three weeks of intensive right-brain training, which involved using complex left-handed movement to initiate picture-naming trials with the purpose of stimulating the pre-SMA in the right-hemisphere. The treatment was administered over 3 weeks, each lasting 3-5 days, depending on the participant, with slight changes in protocol each week. Upon conclusion of the three-week treatment period, participants were provided with a three-segment maintenance program to be completed at home over the course of six weeks. Fluency measures based on four domains of speech: unfamiliar reading, familiar reading, unstructured retell, and structured retell, were obtained at baseline, upon conclusion of each week of treatment, and at follow up, seven weeks post-treatment.

Both participants exhibited decreases in stuttering/secondary behaviors in one of the two domains, although not the same domain. Participant 1 exhibited decreases in stuttering/secondary behaviors during the unfamiliar reading passage task, while Participant 2 exhibited these decreases during the unstructured monologue task. At the end of Treatment Phase Week 3, neither participant showed any change in amount of stuttering/secondary behaviors in the second task, when compared with baseline. Only Participant 1 showed a difference in stuttering frequency when using the left-handed movement, with a slight decrease in behaviors when pairing speech production with this movement.

Participant 1 Results

Participant 1 exhibited decreases in stuttering/secondary stuttering behaviors during the unfamiliar reading passage from baseline to post-treatment measures and follow up, both with and without the paired hand movement. Participant 1 did not exhibit change, on average, in stuttering/secondary stuttering behaviors during the unstructured video retell from baseline to post-treatment and follow up, and showed a slight positive trend towards exhibiting more stuttering behaviors, without the accompanied hand movement but showed decreases in said behaviors when accompanied by the paired hand movement.

Participant 2 Results

Participant 2 exhibited decreases in stuttering/secondary stuttering behaviors during the unstructured video retell from baseline to post-treatment measures and follow up, both with and without the paired hand movement. Participant 2 did not exhibit change, on average, in stuttering/secondary stuttering behaviors during the unfamiliar reading passage from baseline to post-treatment and follow up, both with and without the paired hand movement.

Participant Outcome Similarities and Differences

The results indicate that Participant 1's stuttering behaviors decreased from baseline to post-treatment measures and follow up during the unfamiliar reading passage, but remained unchanged during the unstructured video retell task. She did, however, show a slight decrease in stuttering behaviors both at post-treatment and follow-up when using the paired left-handed movement. Participant 2 exhibited opposite results, decreasing in number of stuttering behaviors from baseline to post-treatment measure and follow up during the unstructured retell, but remaining unchanged during the unfamiliar reading passage task without the paired left-hand movement. She did, however, show a decrease in stuttering behaviors at the end of Treatment Phase Week 3, or post-treatment measures, when using the paired left-handed movement.

Participant 1 noted that she tends to change words when speaking freely in order to avoid stuttering. This may have had an impact on her speech when performing the unstructured retell task, and was more controlled for in the unfamiliar reading task, thus allowing her to exhibit a greater decline in stuttering behaviors during the reading task. At baseline, Participant 2 exhibited a greater amount of stuttering behaviors on average (38 compared to 11), during the unstructured retell when compared to the unfamiliar reading task. In the unstructured retell task, the task in which she exhibited more behaviors at baseline, she showed a greater decrease in stuttering behaviors following the treatment. Participant 2 noted, at the follow-up date, that she felt less nervous speaking in front of people and was experiencing less social anxiety in regards to her speech and stuttering.

Novel Intervention Compared to Traditional Interventions

In a meta-analysis of the effectiveness of treatment methods for PWS, the author found that, when working with AWS, intensive, group, prolonged-speech-type methods, such as fluency shaping and stuttering modification, were effective when paired with self-management and long-lasting maintenance (Bothe et al., 2006). The overall results of the meta-analysis point to maintenance being a crucial element to the lasting effect of these therapies (James, 1981; Ingham, 1982).

The current study used a 7-week maintenance program, as well, following the Intention Treatment. The focus of maintenance was centered on continuous training of the brain, though, rather than on self-regulation and self-management.

The overall results of the meta-analysis also point to an inconsistency with positive results following traditional treatments. Less than half of the articles analyzed provided data collected outside of a clinical setting and many failed to provide information of stuttering frequency, speech rate, or naturalness outcomes post-intervention (Bothe et al., 2006). Fluency interventions seem to have mixed results, especially when effectiveness is observed at follow-up dates, as the effectiveness is greatly determined by maintenance and self-regulation post-treatment. It can also be said that due to human nature and individual strengths and weaknesses, it is difficult to have entirely positive results following behavioral treatment methods such as those traditionally used with PWS (Bothe et al., 2006). The results from the present study are similar to those of current intervention research, in that variability is to be expected due to the variability of fluency in PWS.

Limitations

The results of this study should be interpreted with caution, as this was a pilot study with multiple limitations. The first limitation is that the study used only women, one left-hand dominant the other right-hand dominant. More males stutter than females, and females are more likely to recover from stuttering than males. Additionally, for every young female whose developmental stuttering persists, 3 to 4 males will continue to stutter (Felsenfeld, 1996). The use of a left-handed movement to encourage activation of the pre-SMA in the right hemisphere may or may not have been affected by the hand dominance in either of the participants. As far as the actual intervention, it is difficult to say whether or not there was a right-hemisphere shift due to the lack of brain imaging, though it is important to note that in early studies conducted by Crosson and colleagues (1997, 2007), brain imaging was also not utilized. Further, if the right-hemisphere was activated in the participants during this study, it is impossible to know whether the shift in stuttering behaviors was due to the stimulation of the intention area in the brain or to a general right-hemisphere stimulation, due to the lack of a control intervention, i.e. Attention Treatment utilized by Crosson and colleagues (2007). The absence of fMRI scans, or other neural imaging results, this study is limited in evidencing any changes in underlying mechanism and hemisphere shift following the Intention Treatment.

Another limitation in this study is that the speech samples taken at the end of Treatment Phase Weeks 1 and 2 were not analyzed for stuttering and stuttering behaviors. Though these samples were obtained, and are available to be scored and analyzed at a later date, it is currently unknown how each participant immediately responded to intervention and if there were any differences in response to intervention following each phase. A final limitation is in the difference in dosage of treatment received by participant 1 and participant 2. Participant 1 received a total of 10 treatment sessions per week, for a total of 15 hours of intervention, while participant 2 received 6 treatment sessions per week, for a total of 9 hours of intervention. It is interesting to note, however, that participant 2 exhibited the largest decrease in stuttering symptoms and behaviors, from an average of 38 disfluencies during the unstructured retell at baseline to an average of 20.5 at the end of the treatment phase, despite receiving less intervention.

Clinical Implications and Future Directions for Research

The Novel Intention Treatment introduced in this study may be a viable option for those PWS who have shown low success rates with current interventions, such as stuttering modification and fluency shaping. This treatment eliminates the requirement of self-management, which has proven to be a large contributor to high relapse rates in traditional therapies (McClure & Yaruss, 2003; Eichstadt, Watt, & Girson, 1998; Yairi & Sheery, 2015), as the goal is to train the brain to lateralize speech to the intention area of the right-hemisphere rather than to provide the PWS with strategies/methods to manage their speech.

Future research should be conducted to further understand the effects of this novel intervention on the fluency of PWS. In order to identify whether training the pre-SMA, intention center, of the right hemisphere prior to speech production lateralizes the motor programming and production of speech in PWS to said hemisphere, thus decreasing moments of disfluency. Future research should include using larger numbers of participants, as well as more men and/or children. FMRI, or other neural imaging, should also be utilized to determine whether this intention center of the brain is being stimulated, or if the right hemisphere as a whole is being stimulated during the training sessions. It would also be useful to include a control intervention, such as the

Attention Treatment used by Crosson and colleagues (2007), to obtain further information on which areas of the brain are reacting to this treatment and how.

Summary and Conclusion

The current study examined the effects of a Novel Right Brain Intervention, based strongly on the work of Crosson and colleagues (2007) with patients with anomic aphasia, on the severity and frequency of stuttering in unfamiliar speech tasks in adults with persistent developmental stuttering. The intervention aimed at encouraging the right-hemisphere, specifically the intention area and the pre-SMA, to compensate for the left-hemisphere during the planning and execution of speech, in hopes that this would lead to a reduced stuttering frequency and severity in PWS.

Two female participants received three weeks, and three phases, of the Intention Treatment. Participant 1 received a total of 30, 30-minute treatment sessions, while Participant 2 received a total of 18, 30-minute treatment sessions. Participant 1 demonstrated decreases in stuttering/secondary behaviors during the unfamiliar reading task, while Participant 2 demonstrated said decreases during the unstructured monologue task. At post-treatment neither Participant 1 nor Participant 2 showed any notable change in the total number of disfluencies in the second task, and only Participant 1 showed a decrease in stuttering behaviors when pairing speech with the left-handed circular gesture.

The results of this study should be interpreted with caution, as this is a pilot study with multiple limitations. Future research should involve utilizing a larger number of participants, with an emphasis on examining the effects on men and children; including fMRI and a control intervention, such as the Attention Intervention (Crosson et al., 2007) in order to acquire information on which areas of the brain are being activated and how they are reacting to the intervention; and examining the immediate response to therapy by analyzing weekly data throughout the intervention.

With positive results, this Novel Intention Treatment may become a viable option for PWS who have had less than ideal success with behavioral fluency interventions. Research has shown that self-management and maintenance play a large role in the preservation of progress made in traditional therapies such as fluency shaping and stuttering modification (James, 1981; Ingham, 1982; McClure & Yaruss, 2003; Eichstadt, Watt, & Girson, 1998; Yairi & Sheery, 2015). This right-brain intention treatment eliminates the need for heavy maintenance and self-regulation, and thus may prove to show lower relapse rates in this population with further research.

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