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A case study of a school-age stutterer's response to delayed auditory feedback

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A CASESTUDY OF A SCHOOL-AGE STUTTERER'S RESPONSE TO DELAYED AUDITORY FEEDBACK

A Thesis

by

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ABSTRACT

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Stuttering is a multidimensional disorder that is influenced by hereditary factors, as well as environmental. Numerous methods of treatment exist that address stuttering. However, the Smooth Talking Program (Radford 2001) is unique in its inclusion of mediated learning and delayed auditory feedback. The purpose of this study was to conduct a retrospective analysis of treatment data for a child with moderate to severe dysfluency that was gathered over three summer, five-week sessions with the inclusion of speech motor repatterning exercises during the last summer. The purpose of the analysis is to determine the effects of mediated learning combined with DAF for reduction of fluency in comparison to mediated learning and DAF combined with speech motor repatterning exercises. Results were that stuttering was reduced significantly following stuttering therapy with mediated learning and delayed auditory feedback.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

Introduction

Stuttering is a multifaceted syndrome that can result in devastating experiences and detrimental outcomes for social development and academic performance if not resolved. The population of stutterers is heterogeneous. Stuttering can be broadly divided into two categories: developmental and acquired. Developmental stuttering is stuttering that develops before the age of 21 years, with indicators of a genetic influence and no brain trauma, accidents, or diseases that would result in neurological disabilities and fluency disturbances (Guitar, 1991, Manning, 2001; Rustin, Purser & Rowley, 1987). Acquired stuttering is stuttering that is the result of accident, disease, and/or injury and may occur after the developmental period. The focus of this study is developmental stuttering and the influence of delayed auditory feedback in remediating stuttering in a school-age child, with a typical stuttering profile (ASHA, 1999).

For some developmental stuttering problems, dysfluencies are influenced by motor breakdowns, difficulty in reaction time, auditory problems, and other central factors (brain dysfunction at higher cortical levels). Bloodstein (1993) suggests the primary cause of stuttering is a *defect in the auditory feedback loop, with less influence by other factors.* Research demonstrates that for some who stutter, auditory feedback is a significant factor (Ryan, 2001; Sark, 1996; Zimmerman, 1997; Stager, 1997). A type of

breakdown in the processing of auditory information leads to abherrant dysfluent patterns of speech. These behaviors were recently described in a 1999 Position Paper by *Asha.* Severe stuttering characteristics were described as: pitch rise, part-word repetition, and blocks. Milder stuttering characteristics were reported as: whole-word repetitions, interjections, and use of filler words. If stuttering is **purely** a motor disorder, a dramatic and sudden improvement using auditory feedback is not possible. A pure motor disorder would include some disruption in kinesthetic/proprioceptive abilities at the level of the peripheral system and/or lower motor neuronal level (Starkweather, Armson, & Amster, 1987). For example, Delayed Auditory Feedback (DAF) is not an effective treatment for dysarthria or apraxia. In this research study, the influence of combining the instrumentation of DAF and exercises for sensory integration with mediated learning will be examined in a case study of a school age child who exhibited developmental stuttering and who was a participant in a larger study by Dr. Nola T. Radford. The purpose of this study was to determine if mediated learning combined with DAF was more effective than mediated learning, DAF, and speech motor repatterning exercises.

CHAPTER II

Review of Literature

Nature of Problem to Be Examined

If stuttering is influenced more significantly by central auditory processing factors, with some influence of other factors, DAF should and does have dramatic effects (Ryan, 2001). Delayed Auditory Feedback (DAF) is reported to quickly and dramatically improve the fluency of stutterers. However, the reports are mixed regarding long-term maintenance of fluency **following** treatment with Delayed Auditory Feedback (Kehoe, 2000). In the following sections, background regarding Delayed Auditory Feedback, sensory integration exercises, mediated learning, and the case study will be provided. Case studies are vital for the examination of individual differences. Further, it is critical to examine treatments that are effective for children with substantiated chronic stuttering that will not resolve without clinical intervention. These children are at risk for poor therapeutic outcome.

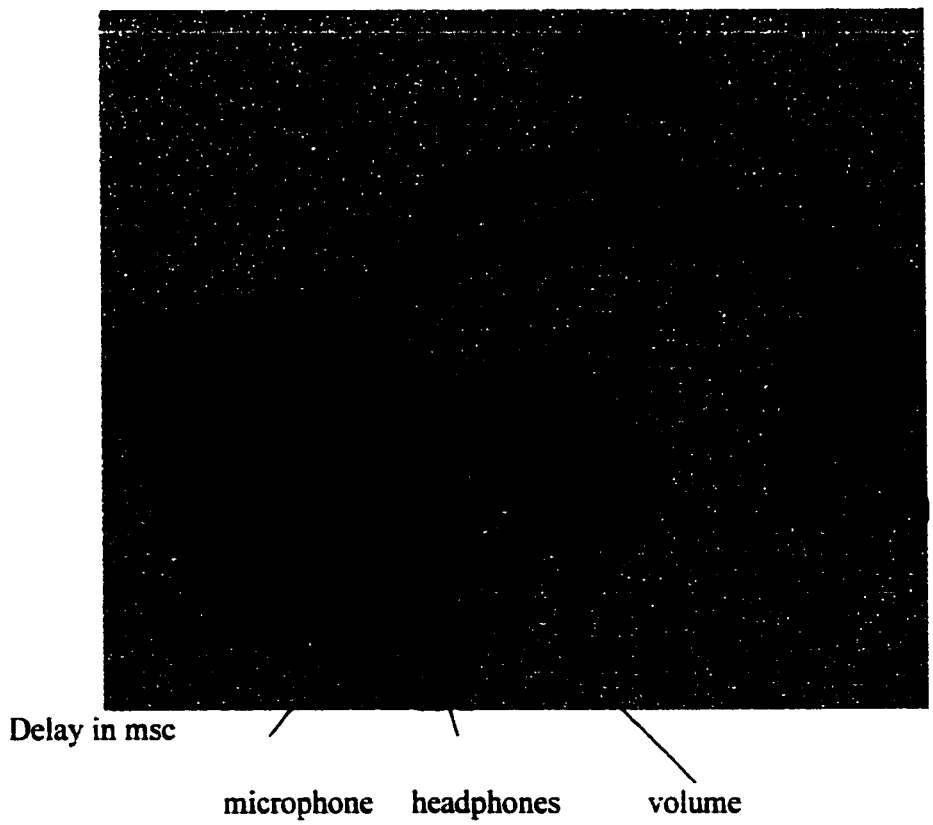
Status of Current Research

Delayed Auditory Feedback

Delayed Auditory Feedback (DAF) is a device that delays voice transmission to a set of headphones a fraction of a second (Kehoe, 2001). The device also consists of two sets of headphones. The client who stutters wears one set of headphones while the

clinician wears another set to be able to monitor the client's speech production and perception of speech delay. The client's headphones have a microphone through which the client speaks. Voice output is delayed at the level of the headphone, with the clinician controlling the amount of delay in increments ranging from 0-260 ms. The client is instructed to listen to his voice before he speaks, thus creating a prolongation. This prolongation induced by delayed auditory feedback has been found to quickly establish fluency in stutterers (2001). See Figure 1 for a picture of a School DAF with a pair of headphones that would be worn by a client.

FIGURE 1: School DAF (Casa Futura Technologies)



History of Delayed Auditory Feedback

Bernard Lee accidentally discovered the DAF in 1950 (Wingate, 1976). The original reference to delay in auditory feedback appeared as a letter to the editor in the Journal of the Acoustical Society of America where Lee commented on Cybernetics, the book by Norbert Weiner (Wingate, 1976). Lee was reportedly working on a tape recorder and accidentally induced delay when he hooked up earphones into the output portion of the recorder (Wingate, 1976). From this point forward, researchers have been fascinated by the fact that DAF often induces stuttering in non-stutterers and fluency in stutterers. Various researchers have experimented with it and developed treatments that center entirely on DAF (Kehoe, 2000; Ryan, 2001).

Major Studies with DAF

Few studies have been completed to examine the long-term benefits of DAF (Armson, 1999 as cited in Ryan 2001). Several studies, however, have been performed to examine the efficacy of DAF in stuttering therapy. In 1974, Van Kirk and Ryan conducted a study using the DAF with 49 subjects who were 9 to 66 years of age (as cited in Ryan, 2001). The subjects received approximately 6.2 hours of treatment. Pre test results indicated a mean of 8.4 stuttered words per minute out of 115.6 words spoken. Post test results indicated a mean of 0.5 stuttered words per minute out of 71.7 words spoken. This was a landmark study, which came to be known as the Bridgeport Project (Ryan, 2001). Another study conducted by Van Kirk and Ryan was performed in the public school system-carried out in the most common clinical setting of the public school under normal school environments with regular speech-language pathologists conducting the therapy. They studied four subjects from ages 7 to 18 years of age. During pre test,

stutterers produced a mean of 6.4 stuttered words out of 119 words spoken. During post testing, stutterers produced a mean of only 0.1 stuttered words per minute out of 39.4 spoken words. These subjects had been asked to use slow, prolonged speech when using the DAF (Ryan, 2001).

One of the latest studies of DAF was performed by Stager in 1997. Stager instructed ten subjects to read slowly for two minutes. Results were that stuttering was decreased by 85% at 195 ms (Kehoe, 2001). In general, the studies show a positive correlation between increased delay and increased fluency during therapy. However, as mentioned earlier, few studies address long-term maintenance of fluency following therapy with DAF. In the 40s, 50s, and 60s, DAF equipment was expensive or impractical to use outside of the university or research setting. Over the years, with improvements in technology, DAF is now lightweight, portable, and easier to use in a variety of settings. Because of these advantages, it is important to determine the benefits of DAF. In spite of the convenience, it is more important to quantify the long-term benefits of the instrumentation.

School DAF

Charles Van Riper predicted in 1974 that a biofeedback computer (portable version) would be developed that would help an adult stutterer become fluent by using the device for a month (Kehoe, 2001). David Kehoe of Casa Futura Technologies sells such a device currently. David Kehoe was a severe stutterer until approximately 30 years of age. He remembers years of stuttering therapy that was not effective. After graduating from a university, Kehoe was taught fluency shaping techniques, which improved his speech in therapy with no transfer of the skills outside of

therapy. Kehoe's experience with "nonproductive" speech therapy continued. According to Kehoe, most of his speech therapists would tell him that he was never going to get better. Kehoe began to work full time developing electronic and biofeedback devices for stuttering. Kehoe's stuttering has changed from severe stuttering to mild stuttering with the use of his biofeedback devices (Kehoe, 2001). Kehoe has been instrumental in producing portable DAF (see Figure 6). The school DAF that Kehoe developed is a small, portable delayed auditory feedback device that was designed to be small enough to fit on a student's desk. Kehoe concluded that a smaller device would be practical to use in schools. During a personal interview with Kehoe (2001) via telephone, he explained that he was influenced by the work of the psychologist, Israel Goldiamond, who utilized the DAF with clients in 1964. Goldiamond's idea was to treat stuttering via punishment and reward. The DAF was used as punishment when the stutterers blocked.

Kehoe recommends in his manuals that the DAF should be used under the supervision of a licensed speech-language pathologist. The DAF range is from 5-250 ms continuous delay. It includes a lightweight set of bilateral earphones.

The outcome of pure DAF therapy is inconclusive (Kalinowski, Stuart, Sark, & Armson, 1996; Kehoe, 2001). A major concern is recidivism and the ability of stutterers to remain fluent. Kehoe speculates that although DAF has been shown to dramatically and quickly improve fluency, questions remain whether the fluency is maintained once the client is no longer using DAF. Kehoe developed speech motor repatterning exercises, which appear to be influenced by Sensory Integration Theory as developed by Ayres (1989).

Speech Motor Repatterning for Stutterers

Speech Motor Repatterning Exercises

Speech Motor Repatterning for Stutterers is a series of intensity drills and cross-lateral exercises developed by Kehoe to help those stutterers who are able to use fluency shaping techniques successfully in therapy but not outside (Kehoe, 2001).

Speech Motor Repatterning for Stutterers is different from other techniques because it includes intensity drills and cross-lateral exercises. Fluency shaping techniques allow the stutterer to use relaxed speech, however, stuttering tenses the muscles used for speech. There is research to support the effectiveness of fluency shaping therapy (Guitar, 1991). There is no research to support motor repatterning for stutterers.

Speech Motor Repatterning for Stutterers involves slow, relaxed, consciously-controlled movements. Additionally, Kehoe (2001) suggests that in order to deeply-learn muscle movements at an automatic level, the speed, and intensity must be increased thus incorporating intensity drills. However, the muscle movements have to be performed correctly. Kehoe reasons that cross-lateral exercises help different parts of the brain communicate with one another and that such exercises are beneficial to stutterers. However, he has no research to support his claims. He bases his assumptions primarily on speculations about the benefits based on positive reports about the influence of sensory integration for learning disabled children and children with other problems. The assumption is that stuttering is the result of some type of neurological breakdown, processing difficulty, or other problems. Therefore, sensory integration should be effective in alleviating stuttering.

Sensory Intergration

Sensory Integration is defined by Ayres (1991) as a "neurological process that organizes sensation from one's own body and from the environment and makes it possible to use the body effectively within the environment." Sensory integration is only one component of sensory processing (1991). According to Ayres (1991), dysfunction in sensory integration (DSI) is defined as the inability to modulate, discriminate, coordinate, or organize sensation adaptively. Ayres (1991) further suggests that treatment for DSI consists of a "sensory-rich" environment, "just right" challenge, and a balanced sensory diet guided by the child's interests, family concerns, and therapist's knowledge (Ayres, 1991).

During an e-mail session with Kehoe in January 2002, he stated that he developed speech motor repatterning exercises based on a book, entitled Smart Moves, written by Carla Hannaford. Hannaford (1995) suggests that in order to make learning easier, people must move and she further explains how to move to fully activate the learning potential (1995). "Nerve networks grow out of our unique sensory experiences," states Hannaford (1995). Hannaford suggests incorporating Brain Gym exercises which activate balanced and equal muscles on both sides of the body (1995). Brain Gym exercises is "coordinated set of integrative movements that enhance learning for everyone" (1995). Hannaford writes her book from an anecdotal point of view.

Stuttering as a Motor Planning Deficit

Kehoe (2001) describes speech as a motor skill. Thus, he sees stuttering as a motor planning deficit (2001). Sensory integration therapy should make it possible for the stutterer to overcome the motor planning deficit (programming that probably occurs

at an unconscious level). This is the reason David Kehoe decided that the missing piece in carry over and maintenance of fluent speech for stutterers is the need for sensory integration therapy, or what Kehoe describes as Speech Motor Repatterning exercises. If stuttering is seen as a result of a motor planning deficit, it can be compared to dyspraxia (Ayres, 1991). Ayres (1991) suggests that motor planning requires attention to plan the messages to send to the muscles and the sequence in which to send them. She further suggests that a child with dyspraxia is poor at motor planning because he does too much motor planning on each task (1991). In other words, he has to think about it over and over again before being able to complete an action.

David Kehoe suggests that the effects of pure DAF therapy are inconclusive so continued concern is "comeback" or recidivism. One issue is how stutterers are counseled to remain fluent long term. Several studies have demonstrated reduced stuttering with an increase in speech rate while using DAF (Kalinowski, Armson, Roland-Mieszowski, Stuart, & Gracco, 1993; MacLeod, Kalinowski, Armson, & Stuart, in press as cited in Kalinowski et. al, 1996). To insure that the benefits are long-term, it may be useful to combine DAF with other strategies to improve transfer and maintenance of fluency skills.

Mediated Learning and Fluency

Clinicians using mediated learning techniques lead students to draw their own conclusions as they learn (Nelson, 1998). The clinician acts more like a facilitator (1998). Mediated learning can also be compared to scaffolding (Radford, 2002). Scaffolding is much like mediated learning because it uses strategic questions and cues to help students see new relationships and expect that all the information will make sense to

the student (Nelson, 1998). According to Radford (2002), "mediated learning typically incorporates visual maps, flowcharts, or other types of visual tools to influence thinking and learning" selected by the clinician. These enable the client to develop mental models, which are representations of their experiences (Wiig & Wilson as cited in Radford, 2002). It is thought that the mental models of a stutterer are subject to being distorted due to their experiences with stuttering. Thus, their mental models support stuttering (2002). Mediated learning is used to establish mental models for fluency and decrease the likelihood of stuttering reoccurrence (2002).

Radford (2002) is the first to develop and report on the influence of mediated learning on the outcomes for fluency training with school age children who stutter. She integrates fluency shaping techniques with mediated learning in the Smooth Talking Program (2002) in order to improve long-term carryover of fluency. Radford is conducting studies to determine whether mediated learning improves stutterers' knowledge of their own patterns of fluency and dysfluency so that stutterers may more efficiently learn to maintain fluency.

Case Study

Case studies are choice designs to study closely variations in response to various clinical methods and to examine individual differences. As a result, the case study was chosen to examine the response of a male child with a typical stuttering profile.

The subject was an 11-year-old boy who was diagnosed with moderate fluency disorder on 8/13/01. The subject in this case study will be referred to as D.W. so as to provide no clues to his real name. (These are not his real initials).

Prior to the Smooth Talking Fluency Clinic, D.W. received speech therapy for nine months in a public school. His school-based speech-language pathologist was concerned about his slow rate of progress in fluency therapy and referred him to the university clinic. He is the older of two siblings and lives at home with his two parents and younger brother. Both of D.W.'s parents are college educated, both work, and belong to high-middle class in socioeconomic status.

Per D.W.'s mother report, he is diagnosed with ADHD for which he has been prescribed medication. As a result of pre and post test results, D.W. was found to exhibit language difficulties. He scored under the expected criterion level for his age. D.W. presents with a typical stuttering syndrome profile (ASHA, 1999).

CHAPTER III

Methodology

D.W. was referred by the speech-language pathologist in his school following a general mail-out of a flyer to local public school districts. The purpose of the flyer was to recruit children with fluency disorders to participate in a fluency "camp."

Pre and Post Test

During each summer term, D.W., was assessed utilizing the Clinical Evaluation of Language Fundamental-Screener (CELF-S), Stuttering Severity Instrument for Children and Adults-3 (SSI-3), analyzed speech-language samples. In addition to these assessments, during the second summer term, D.W. was also assessed using the Assessment of Fluency in School-Age Children (AFSAC). See Table 1 for results. After pre-testing, therapy was conducted for 5 weeks. D.W. attended therapy two times a week for two-hour sessions for a total of 7 sessions. See Table 2 for test results.

During Summer 1, he received therapy that included a structured mediated learning approach combined with DAF. During Summer 2, he received therapy that included a combination of structured mediated learning, DAF, and Speech Motor Repatterning Exercises (SMRE). With parental permission, D.W. was audio and video

taped during each session. During each therapy session, D.W. received 1 hour of individual work per session and approximately 1 hour of group interaction for transfer of fluency skills. Like Treatment 1, therapy lasted 7 sessions.

During post test, D.W. was also assessed with 2 standardized tests (one for language and one for articulation), Clinical Evaluation of Language Fundamental-Screener (CELF-S), Stuttering Severity Instrument for Children and Adults-3 (SSI-3), analyzed speech-language samples. In addition to these assessments, during the second summer term, D.W. was also assessed using the Assessment of Fluency in School-Age Children (AFSAC). See Table 2 for results. During both Summer 1 and Summer 2, a follow-up observation was made of D.W. at school. A copy of the final report was forwarded to the school SLP. See Table 2 for test results.

Summer 2

During Summer 2, to decrease the influence of biased results, the graduate students who were conducting the mediated learning therapy were not involved in delivering the speech motor repatterning exercises. This provided a safeguard for the clinicians from any bias in their pre, post, and daily assessment activities. The exercises as included for D.W. are summarized in the Appendix in Table 1. In addition, the clinicians were also unaware of pre-testing results to decrease chances of biased results.

This researcher transcribed D.W.'s speech samples as did his clinicians and interjudge reliability was calculated by dividing the total dysfluency index calculated by his graduate clinicians and the total dysfluency index calculated by this researcher and multiplied by 100. The interjudge reliability was calculated between 96%-98%.

Data Analysis

D.W.'s stuttering was calculated utilizing the total dysfluency index (Shipley & McAfee, 1998). A dysfluency index is calculated by: 1). Counting the total number of words in the speech sample, 2). Dividing by the total number of dysfluencies, 3). Dividing the total dysfluencies by the total words, and 4). Changing the resultant number to a percentage (1998). During his speech samples, the total words spoken and total words stuttered were calculated. The total number of stuttered words was then divided by the total number of words spoken and changed to a percentage.

Table 1.

Pre and Post Test Results from Treatment 1 for Child Client, D.W.

	CELF-Screener	SSI-3	AFSAC
Pre Test	17 (below criterion level)	Moderate (in severity rating)	N/A
Post Test	N/A	Mild (in severity rating)	N/A

Table 2.

Pre and Post test from Treatment 2 for Child Client, D.W.

	CELF-Screener	SSI-3	AFSAC
Pre Test	21 (below criterion level)	Moderate (in severity rating)	Moderate
Post Test	24 (below criterion level)	Moderate (in severity rating)	Moderate

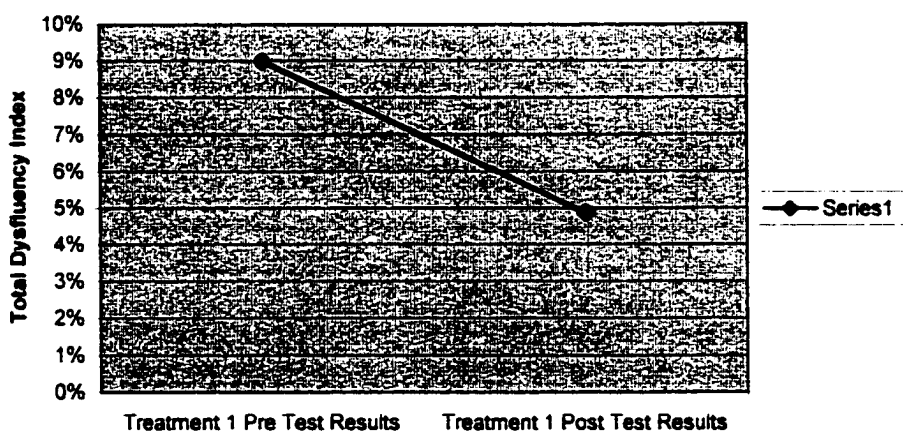
CHAPTER IV

RESULTS

In order to determine the effectiveness of Treatment 1 versus Treatment 2, pre and post measures were examined within each treatment period and between the treatments. Based on the results obtained from pre test in Treatment 1, D.W.'s stuttering was initially calculated at 9% total dysfluency index. D.W.'s post test results during Treatment 1 indicated a total dysfluency index of 4.87%. When compared to his pre test results, D.W.'s stuttering decreased by 4.13% during post test. The slope of decrease was calculated by dividing the difference between pre and post test then divide it by 7 weeks. The slope of decrease for Treatment 1 is 0.59% per week. See Figure 2 for an illustration of these results.

Figure 2.

Treatment 1 Pre Test Results vs Post Test Results

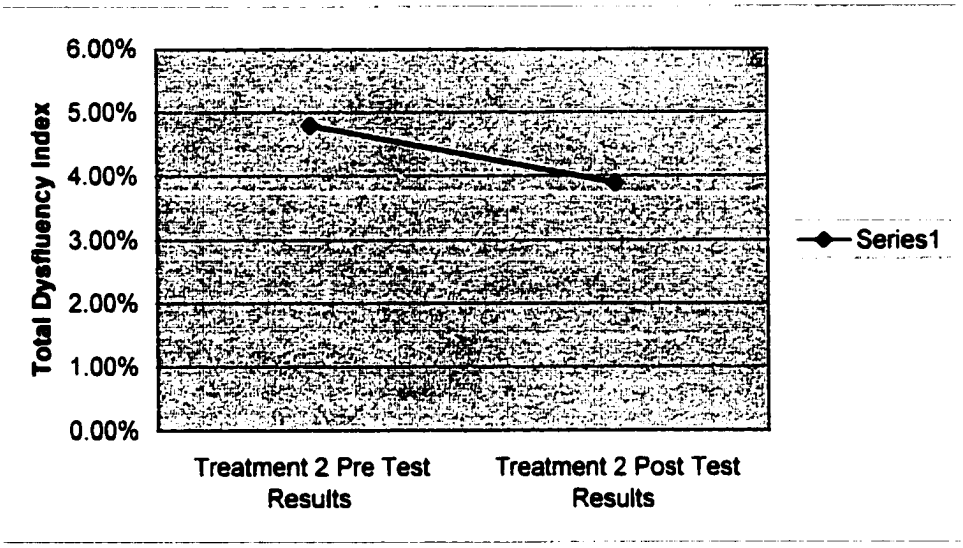


Treatment 1 Pre Test Results vs Post Test Results

Based on the results obtained from pre test in Treatment 2, D.W.'s stuttering was initially calculated at 4.8% total dysfluency index. D.W.'s post test results during Treatment 2 indicated a total dysfluency index of 3.9%. When compared to his pre test results, D.W.'s stuttering decreased by .9% during post test. The slope of decrease for Treatment 2 is 0.13% per week. See Figure 3 for results.

Figure 3.

Treatment 2 Pre Test Results vs Post Test Results



When comparing the results obtained in Treatment 1 and Treatment 2, there is an observable difference in the degree and rate of change between the two treatments. The slope of decrease for Treatment 1 was calculated to be 0.59% per week while, for Treatment 2, it was calculated to be 0.13% per week. During Treatment 1, D.W.'s stuttering decreased with greater magnitude and at a more rapid rate than during the five-week Treatment 2. As illustrated in Figure 4, where both treatments are plotted,

Treatment 1 is characterized by a steeper slope indicating a faster rate of change. Furthermore, at beginning of Treatment 2, D.W.'s stuttering had increased by less than .1% since the end of Treatment 1, thus, indicating the long term effects of Treatment 1. Overall, the degree of change is less during Treatment 2 as determined by a comparison of degree of slope.

Figure 4.

Treatment 1 vs Treatment 2

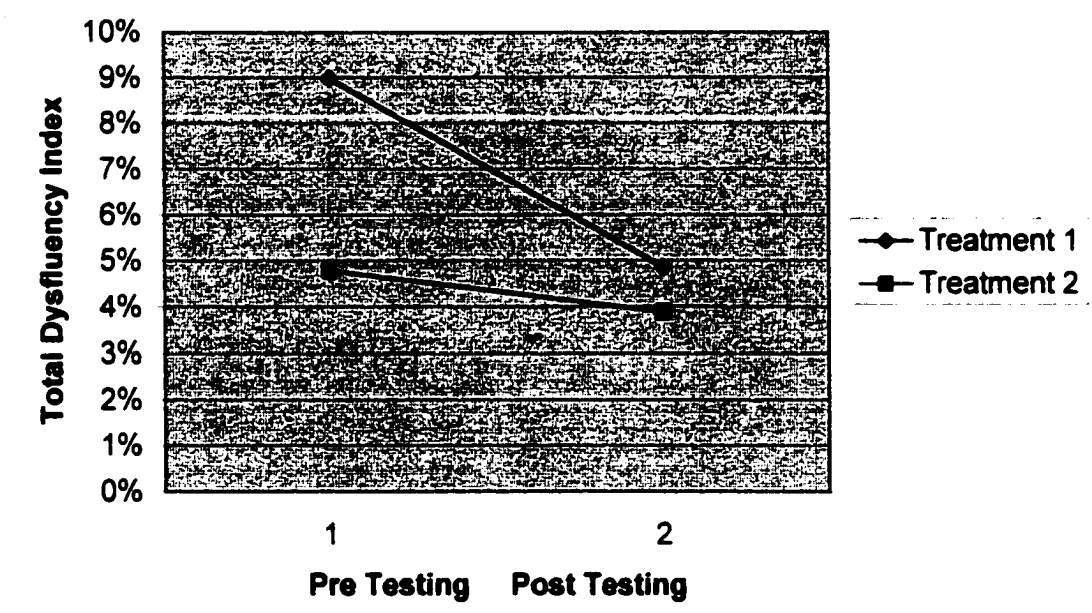


Figure 5A.

Types of Dysfluencies

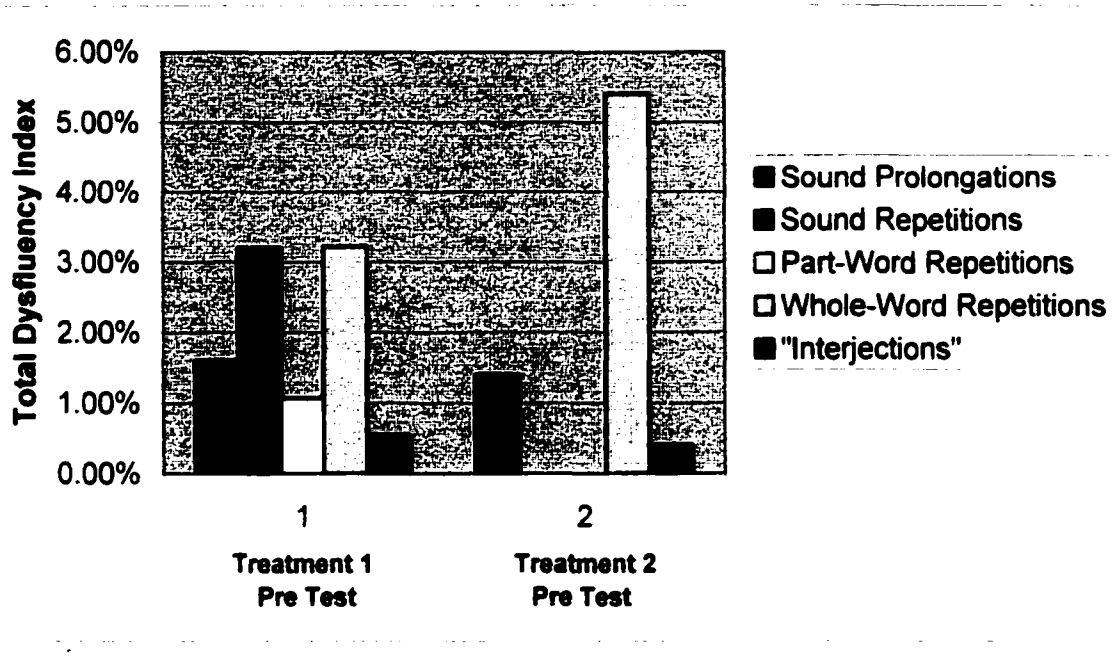


Table 3 is a summary of data as plotted in figure 5A.

Table 3.

Summary of Data in Figure 5A

Types of Dysfluencies	Treatment 1 Pre Test	Treatment 2 Pre Test
Sound Prolongations	1.6%	1.4%
Sound Repetitions	3.2%	
Part-Word Repetitions	1.07%	
Whole-Word Repetitions	3.22%	5.4%
Interjections	0.54%	0.4%

Figure 5B.

Types of Dysfluencies

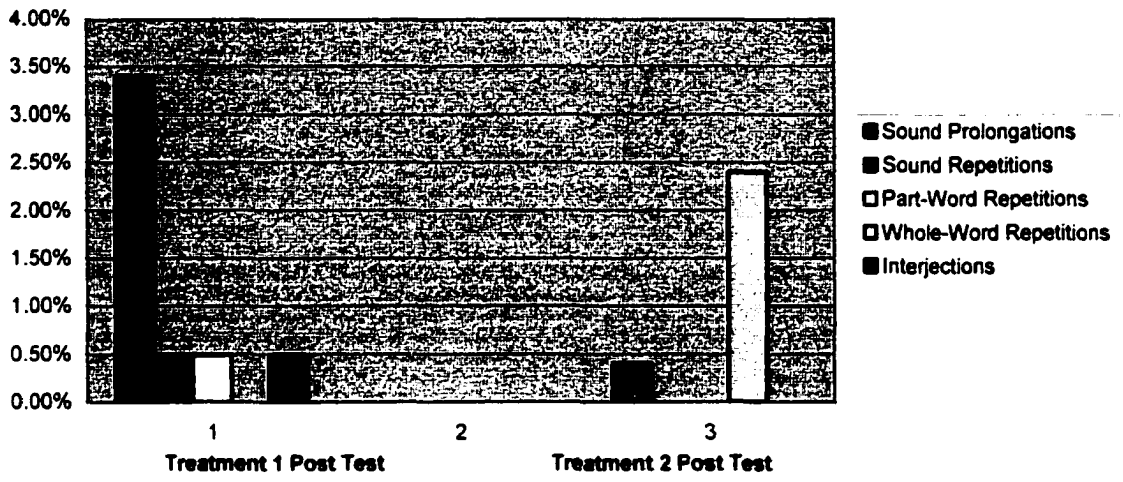


Table 4 is a summary of data as plotted in figure 5B.

Table 4.

Summary of Data in Figure 5B

Types of Dysfluencies	Treatment 1 Post Test	Treatment 2 Post Test
Sound Prolongations	3.4%	0.4%
Sound Repetitions	0.49%	0%
Part-Word Repetitions	0.49%	0%
Whole-Word Repetitions	0%	2.4%
Interjections	0.49%	0%

Table 5.

A Summary of Treatment Procedures for Treatment 1 and Treatment 2

Treatment	# of Sessions	Therapy Structure	Mediated Learning	DAF	SMRE
1	7	1 hour individual 1 hour of group	Yes	Yes	No
2	7	1 hour individual 1 hour of group 30 minutes SMRE	Yes	Yes	Yes

CHAPTER V

Discussion

Stuttering is a complex disorder with serious consequences for children who do not receive appropriate intervention. The purpose of this study was to examine current treatment procedures that have been reported as beneficial for alleviating stuttering. This study was an examination of mediated learning and DAF in comparison to mediated learning, DAF, and speech motor repatterning exercises in the treatment of an 11 year-old monolingual male who exhibited moderate stuttering severity. D.W. is a confirmed stutterer whose SLP reported limited improvement in stuttering during the nine months preceding his enrollment in this study (Asha, 1999; Guitar, 1998).

To briefly summarize the school DAF is an instrument that induces delay in the production-repetition feedback loop of stutterers. This delay elicits slow speech with prolonged vowels which, in turn, causes a stutterer to speak fluently. DAF was used based on behavioral techniques when first developed several years ago. The long-term benefits of DAF are not well described in the literature. Mediated learning is a strategy for teaching fluency that can be combined with any other techniques including DAF. In mediated learning, the child learns strategies for thinking about fluency and maintaining fluency in different speaking situations. SMRE are described as exercises to improve brain functioning. The effectiveness of SMRE in treating fluency disorders in unknown.

In this study, two treatment methods were devised to examine methods for increasing fluency as well as maintaining. Treatment 1 consisted of a combination of mediated learning and DAF. Treatment 2 consisted of a combination of mediated learning, DAF, and Speech Motor Repatterning Exercises. During pre test of Treatment 1, D.W.'s total dysfluency index was 9% while during post test, it was 4.87%. His stuttering decreased by 4.13% during Treatment 1. During pre test in Treatment 2, D.W.'s total dysfluency index was 4.8% while during post test, it was 3.9%. His stuttering decreased 0.9% during Treatment 2. The procedures in Treatment 1, for D.W., were more effective in decreasing dysfluency than the procedures in Treatment 2. The slope of decrease of Treatment 1 was 0.59 while for Treatment 2 it was 0.13. The slope of decrease was greater during Treatment 1 than during Treatment 2. This means that during Treatment 1, D.W.'s stuttering decreased more and at a faster rate. Mediated learning, DAF, and speech motor repatterning exercises during Treatment 2 (see Figure 5) appeared to be less effective than in Treatment 1. The data obtained for Treatment 1 and Treatment 2 can be compared in Figure 5.

Treatment 1 appeared to have long-term benefits for this client over and above therapy received at school. Anecdotal reports regarding D.W.'s improvement during the 9 months of school-based therapy prior to this study were that he was showing minimal to no change in his fluency. His progress in public schools may have been hampered by the structure of therapy (about once per week for 30 minutes). Interestingly, D.W.'s fluency had remained at the same level when post testing results for Treatment I and pretesting results for Treatment 2 were compared. During Treatment 2, his stuttering did decrease minimally as repeated in this discussion several times now. The slow rate of

change during Treatment 2 may be an indicator that he is reaching a plateau and his speech is very close to normal. Any more change in his stuttering may be slow and more difficult to influence.

Anecdotal reports from the teacher are that D.W.'s fluency is significantly improved. This kind of information is important because it is widely accepted and understood that inferential statistical measures are not the only clinically significant results. Descriptive statistics were used here along with anecdotal reports to compare the effectiveness of the two treatments. DAF combined with mediated learning is effective and more research is needed regarding combinations of strategies. The Speech Motor Repatterning Exercises (SMRE) in this study did not result in significant improvement. However, there are some limitations to consider regarding this study.

Limitations of Study

One of the limitations of this study is that detailed measures regarding service delivery during D.W.'s school year are unavailable. Only anecdotal, though, positive, teacher and parents' reports are available. Another limitation is that the full impact of Treatment 2 is unknown because an A-B design was used, with only one administration of each treatment.

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APPENDIX

APPENDIX A

APPENDIX A

Speech Motor Repatterning Exercises (Kehoe, 2001)

TYPE OF EXERCISE	DESCRIPTION OF EXERCISE
1. Drink a glass of water.	Give subject a glass of water to drink.
2. 48 Cross Crawls	While walking in place, lift your left knee and touch it with right elbow; lift your right knee and touch it with left elbow. Continue for 24 pairs.
3. 24 Relaxed Breaths	Complete 24 relaxed, diaphragmatic breathing.
4. Read a word list alternating relaxed and projected speech.	First read the word list out loud then read the same word list loudly and forcefully.
5. 12 Left Lazy 8's	Hold your left thumb at eye level, with your elbow crooked, about 18 inches in front of your nose. Slowly and consciously move your thumb up and in a circle moving across the top of your vision.
6. 12 Right Lazy 8's	Hold your right thumb at eye level, with your elbow crooked, about 18 inches in front of your nose. Slowly and consciously move your thumb up and in a circle moving across the top of your vision.
7. Read a second word list alternating relaxed and projected speech.	Read the second word list out loud then read the same word list loudly and forcefully.
8. Left Hook-Up for 12 breaths	Stand up, and cross your right ankle across your left

	foot. Now cross your right wrist over the left wrist, with your hands in front of you. Then clasp your hands together, interlacing your fingers. Now invert your hands bringing your hands up to your upper chest or collarbone. Rest your tongue on the roof of your mouth behind your teeth. Hold for 12 breaths.
9. Right Hook-Up for 12 breaths	Stand up, and cross your left ankle across your right foot. Now cross your left wrist over the right wrist, with your hands in front of you. Then clasp your hands together, interlacing your fingers. Now invert your hands bringing your hands up to your upper chest or collarbone. Rest your tongue on the roof of your mouth behind your teeth. Hold for 12 breaths.
10. Read a third word list alternating relaxed and projected speech.	Read the third word list out loud then read the same word list loudly and forcefully.
11. 12 both hands Lazy 8's	Clasp your hands together, crossing your thumbs and do another twelve Lazy 8's.
12. Drink more water and talk to people.	Ask subject to drink the remainder of water in the cup and obtain a speech sample.

APPENDIX B

Appendix B

As discussed by Radford (2002):

Mediated learning typically incorporates visual maps, flowcharts, or other types of visual tools to influence thinking and learning. Wiig and Wilson (1998) provide a clear and useful description of mind maps and their presumable tie to the internal mental models or schema that children develop as they learn:

> Mental models can be thought of as internalized, reduced dimension projections, or representations (abstractions) of events, encounters, relationships, or problem situations...Mind maps (conceptual maps) and organizers for constructing knowledge are external, physical representations of events, encounters, relationships, or problem situations. (p.3)

APPENDIX C

Appendix C

Table 4

Schedule of Therapy Sessions for D.W.

Treatment 1

1. 30 minute individual therapy
2. bathroom break
3. 30 minute small group therapy
4. 30 minute large group
5. snack time
6. 30 minute individual therapy

Treatment 2

1. 30 minute session completing SMRE
2. 30 minute individual therapy
3. bathroom break
4. 30 minute small group therapy
5. 30 minute large group
6. snack time
7. 30 minute individual therapy

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