



2005

# A Case Study of Mediated Learning, Delayed Auditory Feedback, and Motor Repatterning to Reduce Stuttering

Nola Radford

*University of Tennessee Health Science Center, nradford@uthsc.edu*

Jesus Tanguma

Marcia Gonzalez

Mary Anne Nerriccio

Denis G. Newman

Follow this and additional works at: [http://trace.tennessee.edu/utk\\_audipubs](http://trace.tennessee.edu/utk_audipubs)

---

## Recommended Citation

Nola T. Radford, Jesus Tanguma, Marcia Gonzalez, Mary Anne Nericcio, and Denis G. Newman. "A Case Study of Mediated Learning, Delayed Auditory Feedback, and Motor Repatterning to Reduce Stuttering." *Perceptual and Motor Skills*, 2005, 101, 63-71.

This Article is brought to you for free and open access by the Audiology and Speech Pathology at Trace: Tennessee Research and Creative Exchange. It has been accepted for inclusion in Audiology and Speech Pathology Publications and Other Works by an authorized administrator of Trace: Tennessee Research and Creative Exchange. For more information, please contact [trace@utk.edu](mailto:trace@utk.edu).

## A CASE STUDY OF MEDIATED LEARNING, DELAYED AUDITORY FEEDBACK, AND MOTOR REPATTERNING TO REDUCE STUTTERING<sup>1,2</sup>

NOLA T. RADFORD, JESUS TANGUMA, MARCIA GONZALEZ,  
MARY ANNE NERICCI, AND DENIS G. NEWMAN

*University of Texas Pan American*

*Summary.*—A case study of DW, an 11-yr. old monolingual, English-speaking boy who exhibits stuttering, language delay, and ADHD is presented. DW experienced only limited improvement during stuttering therapy received in public schools, according to parents and the public school clinician. The purpose of this case study was to assess whether fluency treatment which incorporated Mediated Learning, Delayed Auditory Feedback, and Speech Motor Repatterning would enhance progress. Therapy was delivered in two treatments, with each treatment being 5 wk. of intense therapy, separated by one year. Treatment 1 of combined Mediated Learning and Delayed Auditory Feedback yielded improvement in fluency, judged by parents and the teacher to be clinically significant. The improved fluency was maintained for one year when DW was pretested for participation in Treatment 2, which combined Mediated Learning, Delayed Auditory Feedback, and Speech Motor Repatterning Exercises. As no conclusions are possible, further study is needed.

Stuttering is a multifaceted syndrome which may be associated with devastating experiences and detrimental outcomes for the social development and academic performance of children (ASHA Special Interest Division, 1999). The complexity of stuttering, combined with the variability in personality and cognitive abilities of children, can pose challenges in treatment. Hancock, Craig, McCreedy, McCaul, Costello, Campbell, and Gilmore (1998) in long-term study of stuttering therapies found fluency shaping, fluency shaping plus child-parent interaction therapy, and EMG feedback were equally effective in long-term maintenance of fluency in school-age children, ages 9 to 14 years. The researchers suggested variations of treatments using fluency shaping and operant approaches were equally effective in establishing fluency which was maintained through 6 years posttreatment. Also, they stated the wide variety of available treatments currently in practice is advantageous given the variability in child clients and the need to individualize treatment for the best outcome.

---

<sup>1</sup>This research was partially funded by a research grant from the Faculty Research Council of the University of Texas Pan American. Help of Mr. Vishnu Rohith Guttapalem, Research Assistant, is acknowledged.

<sup>2</sup>Address correspondence to Nola T. Radford, Department of Communication Sciences and Disorders, University of Texas Pan American, 1201 West University Drive, Edinburg, TX 78541 or e-mail (ntradford@sbcglobal.net).

The purpose of this case study was to examine whether fluency treatments which incorporated Mediated Learning or Delayed Auditory Feedback would be equally effective treatments for stuttering and whether these treatments were effective in promoting change and preventing relapse in a school-age child who had made limited progress after 9 mo. of fluency therapy in a school setting.

Case studies can contribute to examination of individual differences. The current case provided a unique opportunity to study developmental stuttering by a child who exhibited the characteristics of the "stuttering syndrome." The ASHA Special Interest Division (1999) summarized various definitions of stuttering, including a description of stuttering as a "syndrome," with a significant number of children exhibiting a constellation of difficulties, including vocabulary delays, restricted grammar, reading problems, and attention problems. The greater the number of related problems, the greater the likelihood that the prognosis for improved fluency is poor and the potential for relapse is greater (Silverman, 1981; Conture & Guitar, 1993; Bloodstein, 1995; Hancock, *et al.*, 1998).

DW exhibited this constellation of difficulties which might have offered some explanation for his lack of progress in school therapy. So, in planning to improve the therapeutic outcomes for DW and safeguard against relapse, intervention was designed to include delayed auditory feedback, mediated learning, and other strategies. Only brief discussion of these components, as related to the planning for DW, is provided.

#### *Delayed Auditory Feedback Studies*

Studies of the long-term benefits of delayed auditory feedback on stuttering are few (Armson & Stuart, 1998; Ryan, 2001). However, several studies have examined the immediate efficacy of delayed auditory feedback in stuttering therapy. In 1974, Ryan and Van Kirk conducted a landmark study, The Bridgeport Project, using delayed auditory feedback with 49 subjects ranging in age from 9 to 66 years of age as cited by Ryan (2001). At pretest the mean was 8.4 stuttered words per minute out of 115.6 words spoken per minute. Subjects received approximately 6.2 hr. of treatment. At posttest the mean was 0.5 stuttered words per minute out of 71.7 words spoken per minute. Another study (Ryan & Van Kirk Ryan, 1995) was carried out in a normal school environment by school speech-language pathologists with 24 subjects, ages 7 to 17 years. During pretesting conditions, stutterers used slow, prolonged speech and, when using delayed auditory feedback, produced a mean of 7.5 stuttered words out of 112.6 words spoken per minute. During posttesting, stutterers produced a mean of only 0.3 stuttered words per minute out of 77.9 words spoken per minute.

Kehoe (2000) developed a portable delayed auditory feedback device

for school-age children. The delayed auditory feedback device can be placed on a student's desk. Kehoe recommends in his manuals that the delayed auditory feedback device should be used under the supervision of a licensed speech-language pathologist. The outcome of pure Delayed Auditory Feedback therapy is inconclusive (Kalinowski, Stuart, Sark, & Armson, 1996; Kehoe, 2000). Kehoe also provides a series of Speech Motor Repatterning Exercises (SMRES) influenced by the work of Ayres (2000) and Feldenkrais (1966) in physical therapy. Kehoe reasoned that because speech is a motor skill, sensory integration therapy should be useful in resolving stuttering.

Current research also provides justification for therapy that incorporates mediation to influence how children think about speech, plan, monitor, and modify speaking, which involves metacognitive abilities. More recent studies of brain anatomy and brain imaging during overt speech indicate the complex, simultaneous, and multiple activations that affect speech in general and fluency in particular (Small, 2003). In summarizing recent advances in neurobiology of stuttering, brain scan data indicate differences in cortical activation during speaking between adult stutterers and nonstutterers (Conture & De Nil, 2004). During speech tasks, adult stutterers showed more activation in the right hemisphere than nonstutterers; however, after 3 wk. of treatment, more widespread left hemisphere activation, similar to nonstutterers, was observed.

Conture and De Nil's work (2004) supports the notion that fluency is not influenced by "bottom-up" or "top-down" processes, but by complex patterns of activation throughout the brain. As children and adults are better able to think about, monitor, and change their own behavior and use "top-down" processes for managing speaking, they may also use executive functions to maintain fluency. Counseling and other mediation techniques often include metalinguistic strategies for improving fluency. Further, Conture and De Nil (2004) provided evidence that fluency therapy normalizes how the brain handles speech, and this is associated with observable changes in fluency.

#### *Mediated Learning and Fluency*

Clinicians using mediated learning techniques lead students to draw their own conclusions as they learn, as the clinicians act like facilitators (Wiig & Wilson, 1998). Mediation included aspects of counseling, a way of "being" with children (Schneider, 2002). The goal of counseling is to form therapeutic relationships which nurture positive emotions and attitudes in children and adults about speech. Counseling included encouraging the child to think in different ways about stuttering and reduce negative maladaptations to stuttering, speaking, life, and self (Schneider, 2002). Such counseling may influence internal models for speech production. Mediated learning, a meta-

linguistic strategy, according to Radford (2002), “typically incorporates visual maps, flowcharts, or other types of visual tools to influence thinking and learning” (p. 2). The visual tools selected by the clinician enable the client to develop mental models to represent experience (Wiig & Wilson, 1998, cf. as cited by Radford, 2002). Mediated learning can be used to establish mental models for fluency and decrease the likelihood of the re-occurrence of stuttering (Radford, 2002).

#### *A Structured Therapy Program With Mediated Learning*

The structured program by Radford (2002) is a series of mediations within the context of a series of structured lessons to establish 13 behaviors to promote fluency and reduce stuttering. It is assumed that stutterers have well-developed schemas for stuttering and underdeveloped schemas for fluency. Therapy, therefore, begins with focus on positive reinforcement for practicing new behaviors, thinking in new ways, talking in new ways, and listening. Initial therapy includes emphasis on establishing or improving persistence (practice), cognitive flexibility (to consider multiple perspectives), fluent speech (through fluency shaping, stuttering modification, or an approach that combines these), and listening (to establish recognition and comparison of fluency and disfluency). As the child progresses in development of fluency and during the middle stages of therapy, the clinician works to establish the child’s use of prior knowledge (learning from prior experience or rethinking experiences through the use of mapping techniques), precision of thought (exercises to focus attention), and using all senses to establish fluency. During the latter stages, the clinician structures therapy to develop the child’s creativity, reflection (self-monitoring, self-criticism, and self-praise), metacognition, and precision of language (increasing vocabulary, desensitization regarding specific word fears). During the final stages, more emphasis is placed on application to new situations independent of the therapist, promotion of curiosity and enjoyment of talking, and checking for accuracy and precision of speech.

#### CASE STUDY

The subject, an 11-yr.-old boy (DW), was diagnosed with a moderate fluency disorder on August 13, 2001. Prior to the Smooth Talking Fluency Clinic, he received speech therapy over nine months in a public school program. There was a concern about his slow progress in fluency therapy; he was referred to the first author. He is the older of two siblings and lives at home with his parents and younger brother. Both parents are college-educated, both work and are of high-middle socioeconomic status.

According to the mother’s report, DW was diagnosed with ADHD, for which he has been prescribed medication. At pre- and posttest, DW present-

ed language difficulties, scoring under the expected criterion for his age. He presented a typical stuttering syndrome profile based on description published by the American Speech Language-Hearing Association (1999).

### *Method*

DW was referred by the speech-language pathologist at his school, following a general mail-out of a flyer, to recruit children with fluency disorders, to participate in a fluency group.

*Pre- and posttesting.*—During the first summer term, DW was assessed utilizing the Clinical Evaluation of Language Fundamentals–Screeners (CELF–S), Stuttering Severity Instrument for Children and Adults–3 (SSI–3), and speech-language samples. He was also assessed during the second summer term using the Assessment of Fluency in School-age Children, see Table 1. After pretesting, 5 wk. of therapy require attendance twice a week for 2-hr. sessions, totaling seven sessions in all; see Table 1 for test data.

TABLE 1  
PRE- AND POSTTEST RESULTS FROM TREATMENTS 1 AND 2 FOR CHILD CLIENT DW

Treatment	CELF–Screeners	SSI-3	AFSAC
1 Pretest	17 (below criterion level)	Moderate Severity	N/A
Posttest	N/A	Mild Severity Rating	N/A
2 Pretest	21 (below criterion level)	Moderate Severity	Moderate
Posttest	24 (below criterion)	Moderate Severity	Moderate

During Summer I, his therapy was a structured mediated learning approach combined with delayed auditory feedback. An integrated approach to speech training was incorporated, with DW participating in fluency shaping and stuttering modification therapy. During Summer II, he received a therapeutic combination of 12 different activities of structured mediated learning, delayed auditory feedback, and Speech Motor Repatterning Exercises. For example, drinking a glass of water, doing simple exercises, relaxed breathing, and reading alternating word lists (Kehoe, 2000). With parental permission, DW was audio- and videotaped during each session. DW received 1 hr. of individual work per session, and approximately 1 hr. of group interaction to transfer learned fluency skills. Like Treatment 1, there were seven sessions.

Delayed auditory feedback was included in at least half of each session. DW was instructed to talk about a topic and was told that he would hear changes in how he heard his voice while talking. He was instructed to slow down as he heard the changes and not “fight” to talk faster than he could hear his voice. The delay in feedback was increased in sequence from 0, 30, 90, 120, to 200 msec. until DW could produce stutter-free, prolonged

speech. The delay was gradually decreased during conversation until stuttering was eliminated or reduced without decreases in fluency. If stuttering occurred during this descending phase, the delay was increased again until fluency was regained. The delay was decreased again. Once the minimal delayed auditory feedback with maximum fluency was achieved, DW was given increasingly longer segments to read, ranging from single words to short stories of 50 to 100 words.

During pretesting, DW was assessed with two standardized tests, one for language and one for articulation. They included the Clinical Evaluation of Language Fundamental-Screener, and the Stuttering Severity Instrument for Children and Adults-3 for analyses of speech-language samples. During the second summer term, DW was also assessed using the Assessment of Fluency in School-age Children. During both Summer I and Summer II, a follow-up observation was made of DW at school. A copy of the final report was forwarded to the speech-language pathologist at the school.

*Summer II.*—During Summer II, the graduate students conducted the mediated learning therapy after speech-motor repatterning exercises were provided by a different graduate student so the former were unaware of that training. These clinicians had no information also of DW's responses from the prior summer's training. By establishing the double blind, safeguards were provided for the clinicians in their pretest, posttest, and daily assessment activities. The fluency lessons incorporated in DW's therapy from Radford's structured therapy included selected worksheets and training for identification of stuttering, mapping to identify and compare strategies for talking, and techniques to modify or eliminate stuttering (delayed auditory feedback, pseudostuttering or bouncing, stretching, light contact, and cancellation techniques). The third author and the graduate students transcribed DW's speech samples. Interjudge reliability was estimated by dividing the total disfluency index calculated by the graduate clinicians and the total disfluency index calculated by this researcher and multiplied by 100. The interjudge reliability ranged from 96% to 98%.

*Data analysis.*—DW's stuttering was calculated utilizing the total disfluency index (Shipley & McAfee, 1998). A disfluency index is calculated by counting the total number of words in the speech sample, dividing by the total number disfluencies, dividing the total disfluencies by the total words, and changing this coefficient to percent. During his speech samples, the total words spoken and the total words stuttered were tabulated, then divided by the total number of words spoken and changed to percent.

### *Results*

To judge the effectiveness of Treatment 1 versus Treatment 2, pre- and posttreatment measures were examined within each period and between

treatments. Pretest for Treatment 1, DW's stuttering gave a 9.0% total disfluency index. His posttest was 4.8%, a decrease of 4.1%. The slope of the decrease was calculated by subtracting the difference between pre- and post-test scores and dividing the difference by 7, which provided a measure of the average change per week. The slope of the decrease for Treatment 1 is .6% per week, over 5 wk.

At the pretesting in Treatment 2, DW's stuttering initially gave a total disfluency index of 4.8% and the posttest for Treatment 2 a total disfluency index was 3.9%, so stuttering decreased by .9% during posttest. The slope of decrease for Treatment 2 is .1% per week.

When comparing the results obtained in Treatments 1 and 2, difference in the amount and rate of change was observable. During Treatment 1, stuttering decreased more rapidly than during Treatment 2. At the beginning of Treatment 2, stuttering had increased by less than .1% since the end of Treatment 1, suggesting longer term effects of Treatment 1. Overall, the change was less during Treatment 2, as indicated by the slope. See Table 2.

TABLE 2  
DISFLUENCY TYPES (PERCENT) OBSERVED IN DW'S SPEECH DURING PRETEST AND POSTTEST

Types of Disfluencies	Pretest		Posttest	
	Treatment 1	Treatment 2	Treatment 1	Treatment 2
Sound Prolongations	1.6	1.4	3.4	0.4
Sound Repetitions	3.2		0.5	0.0
Part-word Repetitions	1.1		0.5	0.0
Whole-word Repetitions	3.2	5.4	0.0	5.4
Interjections	0.5	0.4	0.5	0.4

## DISCUSSION

Stuttering is a complex disorder with serious consequences for children who do not receive the appropriate intervention. The present purpose was to examine several current treatment procedures reported as beneficial for alleviating stuttering and facilitating long-term maintenance of fluency. This case study of an 11-yr.-old boy who presented with stuttering and ADHD was a preliminary examination of mediated learning and DAF in comparison to mediated learning, DAF, and Speech Motor Repatterning Exercises in the treatment of this boy. By parental and public school clinician's reports, DW experienced limited improvement during stuttering therapy in the nine months preceding his enrollment in this study.

Results support the assumption that mediated learning strategies are associated with a reduction in stuttering and maintenance of fluency. Treatment 1 appeared to have longer-term benefits for this boy after his prior 9 mo. of therapy. The clinician's referral was based on the minimal change in



fluency. Following this study, the teacher reported that DW's fluency improved. Such comment is important because it is widely understood that inferential statistics are one kind of important information. Clinically significant information was also evident in anecdotal report of changes.

A primary limitation of this study was the unmeasured magnitude and nature of the effects of ADHD on stuttering. Secondly, no specific diagnostic measures and therapeutic procedures used during DW's school therapy were available. Thirdly, only subjective, teacher's and parent's anecdotal reports on improved fluency were provided. Also, the effect of Treatment 2 is unknown because an A-B design was used, with only one administration of each treatment. Thus, no conclusions are possible.

Planned longitudinal studies will incorporate more extensive baseline procedures, intra- and intergroup comparisons of mediated learning, speech motor repatterning, and combined DAF speech-motor repatterning to reduce or eliminate stuttering. Data from a larger sample would allow clear statistical assessment, including questions of whether mediated learning combined with delayed auditory feedback is an effective treatment for the remediation of stuttering and prevention of relapse, whether mediated learning combined with delayed auditory feedback is more effective than Speech Motor Repatterning Exercises combined with delayed auditory feedback, and identification of the neurobiological consequences of mediated learning for the resolution of stuttering.

#### REFERENCES

- AMERICAN SPEECH AND HEARING ASSOCIATION SPECIAL INTEREST DIVISION 4: FLUENCY AND FLUENCY DISORDERS. (1999) Terminology pertaining to fluency and fluency disorders: guidelines. *ASHA*, 41(Suppl. 19), 29-36.
- ARMSON, J., & STUART, A. (1998) Effect of extended exposure to frequency-altered feedback on stuttering during reading and monologue. *Journal of Speech, Language, and Hearing Research*, 41, 479-490.
- AYRES, J. (2000) *Sensory integration and the child*. Los Angeles, CA: Western Psychological Services.
- BLOODSTEIN, O. (1995) *A handbook on stuttering*. (5th ed.) San Diego, CA: Singular.
- CONTURE, E. G., & DE NIL, L. (2004) Stuttering in 2004: translating scientific evidence to clinical practice. Presentation at the annual conference of the American Speech-Language Hearing Association, Philadelphia, PA.
- CONTURE, E. G., & GUTAR, B. (1993) Evaluating efficacy of treatment of stuttering: school-age children. *Journal of Fluency Disorders*, 8, 253-287.
- FELDENKRAIS, M. (1966) *Body and mature behavior: a study of anxiety, sex, gravitation and learning*. New York: International Universities Press.
- HANCOCK, K., CRAIG, A., MCCREADY, C., MCCAUL, A., COSTELLO, D., CAMPBELL, O. E., & GILMORE, G. (1998) Two to six-year controlled-trial stuttering outcomes for children and adolescents. *Journal of Speech, Language, and Hearing Research*, 41, 1242-1252.
- KALINOWSKI, J., STUART, A., SARK, S., & ARMSON, J. (1996) Stuttering amelioration at various auditory feedback delays and speech rates. *European Journal of Disorders of Communication*, 31, 259-269.
- KEHOE, D. (2000) *Speech motor repatterning for stutterers*. Boulder, CO: Casa Futura Technologies.

- RADFORD, N. T. (2002) *Smooth talking: a therapy program for children who stutter*. San Francisco, CA: Singular Publ./Thompson Learning.
- RYAN, B. P. (2001) *Programmed therapy for stuttering in children and adults*. (2nd ed.) Springfield, IL: Thomas.
- RYAN, B. P., & VAN KIRK RYAN, B. (1995) Programmed stuttering treatment for children: comparison of two establishment programs through transfer, maintenance, and follow-up. *Journal of Speech and Hearing Research*, 31, 61-75.
- SCHNEIDER, P. (2002) Planting a lifetime of success. *Perspectives-Fluency and Fluency Disorders*, January, 2001, 13-14.
- SHIPLEY, K. G., & MCAFEE, J. G. (1998) *Assessment in speech-language pathology: a resource manual*. (2nd ed.) Clifton Park, NY: Delmar Learning.
- SILVERMAN, F. (1981) Relapse following stuttering therapy. In N. J. Lass (Ed.), *Speech and language: advances in basic research and practice*. Vol. 5. New York: Academic Press. Pp. 52-75.
- SMALL, S. (2003) Magnetic resonance imaging of motor function and dysfunction. In L. Shriberg & T. Campbell (Eds.), *Proceedings of the 2002 Childhood Apraxia of Speech Research Symposium: Current Research and Research Methods*. Carlsbad, CA: The Hendrix Foundation. Pp. 127-136.
- WIGG, E. E., & WILSON, C. (1998) *Visual tools for language and communication*. Chicago, IL: Applied Symbolix.

*Accepted June 20, 2005.*