THE DIFFERENTIAL EFFECTS OF THREE EXTERNAL AUDITORY STIMULI ON STUTTERING BEHAVIORS

Thesis for the Degree of M. A.

MICHIGAN STATE UNIVERSITY

GEORGENE MAE NORRIS

1975

ABSTRACT

THE DIFFERENTIAL EFFECTS
OF
THREE EXTERNAL AUDITORY STIMULI
ON STUTTERING BEHAVIORS

By

Georgene Mae Norris

It was the purpose of this investigation to compare the effects of the metronome, auditory masking and delayed auditory feedback on specific dysfluency types exhibited by adult stutterers. Subjects were twelve normal hearing, adult stutterers ranging in age, from 17 to 48, and in stuttering severity. Each subject participated in three experimental conditions (metronome, auditory masking and delayed auditory feedback), in addition to a control condition. During each condition, the subjects spoke spontaneously for three minutes and read a paragraph containing 200-250 syllables. The speech of the subjects during each condition was recorded. All subjects completed a questionnaire at the end of their fourth recording session, designed to discover their impressions concerning the effectiveness of each condition in reducing stuttering.

The taped speech samples were analyzed for frequency of stuttering by dysfluency type. Specifically, six dysfluency types were identified: part syllable repetitions, whole

syllable repetitions, multi-syllable repetitions, prolonged articulatory postures, laryngeal abberations and interjections.

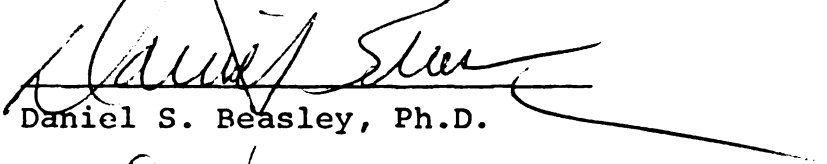
Results revealed the metronome to be the only condition which produced a significant reduction in dysfluencies during conversational speech. However, during oral reading, the metronome, DAF and masking conditions showed significant reductions in dysfluencies. The metronome also demonstrated significant decreases in dysfluencies when compared to the DAF and masking conditions, which, in turn, yielded no significant differences when compared to each other. The response of the six individual dysfluency types to the experimental conditions differed between conversational speech and oral reading. Whole syllable repetitions emerged as the only dysfluency type to demonstrate a reduction in frequency across conditions during both conversational speech and oral reading. The metronome condition produced the most consistent dysfluency type response. Metronome pacing produced reductions in all dysfluency types during oral reading and conversational speech, with the exception of laryngeal abberations, which increased in frequency during conversational speech.

The results are discussed with reference to previous research. Theoretical and clinical implications as well as implications for further research are also presented.

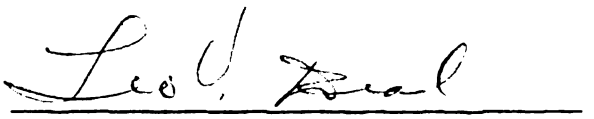
Accepted by the faculty of the Department of Audiology and Speech Sciences, College of Communication Arts, Michigan State University, in partial fulfillment of the requirements for the Master of Arts Degree.

Thesis Committee: _____ Director

John M. Hutchinson, Ph.D.



Daniel S. Beasley, Ph.D.



Leo V. Deal, Ph.D.

THE DIFFERENTIAL EFFECTS OF THREE EXTERNAL AUDITORY STIMULI ON STUTTERING BEHAVIORS

by

Georgene Mae Norris

A THESIS

Submitted to
Michigan State University
In partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

Department of Audiology and Speech Sciences

1975

To the family I love: Gram, Gramps, Mom, Bob and Gayle

Thank you all - for EVERYTHING.

ACKNOWLEDGEMENTS

My sincere thanks are extended to all of my subjects for being so generous with their time and patience. A special thank - you to Timothy Gallagher, my right hand man, for his assistance whenever it was needed.

My appreciation to the members of my committee, Dr. Daniel S. Beasley and Dr. Leo V. Deal, for their efforts on my behalf.

Most of all, I wish to express my deepest gratitude to Dr. John M. Hutchinson, for being my inspiration, and director, my counselor, and my friend. His valuable assistance throughout the preparation of this thesis shall never be forgotten.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

Review of the Literature

Historically, a reduction in stuttering has been demonstrated in the presence of external stimuli. Bloodstein (1950) cited 115 conditions which were reportedly associated with improved fluency. However, three principal sources of external auditory stimulation have emerged as common clinical procedures for fluency building: rythmic stimulation, auditory masking, and delayed auditory feedback.

Rhythmic Stimulation

Van Riper (1971) provided an interesting historical account of the therapeutic uses of rhythmic stimulation for fluency disorders. He accorded the British physician, Thewall (1764), with the first public advocacy of rhythmic controls for stutterers. Since that time, therapy techniques involving rhythmic stimulation have been used widely. In the early 1900's, several stammering schools which used pacing techniques, experienced a loss of ethical credibility; and by association, the use of rhythmic stimuli was also discredited (Hutchinson, 1974). Two additional factors contributed to the abandonment of pacing as a clinical tool. First, its ameliorative effects could not be easily explained

and, secondly, the improvement in fluency was transient since effective carry - over procedures could not be found.

Despite the clinical rejection of pacing procedures, investigators began systematically to study the effects of rhythmic stimuli upon dysfluent speech. The first documented experiments involving the effects of rhythm on the speech behavior of stutterers were conducted by Johnson and Rosen (1937). They reported the largest reduction in the number of dysfluencies among subjects who read in a regular, rhythmic fashion as compared to other reading variations such as whispering, singing, reading at high and low intensity levels, and choral reading. In a follow-up study, Barber (1940) confirmed that imposed rhythms, such as bodily rhythms and rhythmic sensory stimulation (auditory, visual,and tactile),were associated with sizeable decrements in stuttering. More recently, there has been a revival of interest in using the metronome as a means to increase the fluency of stutterers. The introduction of a portable behind-the-ear metronome by Meyer and Mair (1963) made the use of rhythmic stimulation more practical for stutterers in everyday situations and resolved to some extent the problem of clinical carry-over. Subsequently, Brady (1969, 1971) developed a complete therapy program combining modern behavior therapy procedures and metronome conditioning. He reported that 23 subjects exhibited an improvement of over 90% in the fluency of their speech after progression through Brady's Metronome-Conditioned Speech Retraining (MCSR) program.

Auditory Masking

High intensity masking noise has also received considerable attention as a technique for improving fluency. Part of this interest grew out of Backus' (1938) observation that only 0.4% of the 13,691 oral deaf or partially deaf population sampled were stutterers. This relatively low incidence of deaf stutterers gave rise to the hypothesis that stuttering may be related to hearing sensitivity. In an attempt to discover whether the number of dysfluencies would decrease if auditory cues were reduced or absent, Shane (1946) presented masking noise to 25 stutterers at the levels of 25dB and 95dB. The results demonstrated that a 25dB level produced no significant change in stuttering frequency. However, subjects receiving a masking noise of 95dB exhibited an 83.5% reduction in dysfluency. Shane concluded that this reduction was due to the fact that the subjects were relatively unable to hear their own voice, and were therefore free from the anxiety producing cues involved in hearing themselves stutter (p.293).

Cherry and Sayers (1956) reported almost complete elimination of stuttering when subjects were presented with a tone bilaterally, the intensity of which approached pain level (p. 237), whereas it completely masked the subject's awareness of his own voice (p. 237). Similarly, Maraist and Hutton (1957) presented five levels of masking noise to 15 young adult stutterers. They found that both the number of dysfluencies and total reading time decreased as the level of masking noise

increased. In fact, the subjects improved significantly at the 50dB level as indicated by a decrease in stuttering of 31% and a reduction in reading time of 41%.

The portable masking unit, developed by Perkins and Curlee (1969), has been shown to be successful in reducing the dysfluencies in the daily speech of stutterers. The device, which is the size of a hearing aid, is capable of producing a signal pulse, with an adjustable frequency of 25.6Hz to 590Hz. The sound pressure level of the signal can be adjusted from 94.5dB to 118dB. The portable masking unit, therefore, seems to be a valuable tool in the establishment of carry-over from speech therapy to everyday speech.

Delayed Auditory Feedback

Following the original findings of Lee (1950) and Black (1951) that delayed auditory feedback (DAF) promoted temporal disruptions in the speech of normal talkers, several investigators sought to determine the effects of this stimulus on stutterers. The common finding was that DAF tended to promote fluency in dysfluent talkers. Among the more important observations was that of Neelley (1961) who subjected 23 normal speakers and 23 stutterers to a delay time of 14 mesc at 75dB HL. As expected, stutterers became more fluent under DAF. However, the dysfluencies of normal speakers were not observed to be qualitatively similar to those of stutterers.

In an attempt to assess the effects of different delay times on stuttering frequency, Ham and Steer (1967) observed

reduced stuttering frequency for a wide range of delay times (.100, .200, .400, and .800 sec.). More recently, Hutchinson and Burk (1973) confirmed that a group of nine stutterers exhibited a decrease in total pause duration and an increase in phonation time under the delay levels of 100, 200, and 300 msec.

Ryan and VanKirk (1974) developed an operant program for the treatment of stutterers, using DAF as the means through which "slow, prolonged, fluent speech" patterns could be produced (p. 3). The progression of the program followed systematic procedures and regular reinforcement schedules. The program consisted of three phases: (1) Establishment phase, which attempted to develop fluent conversational speech under the conditions of DAF, (2) the transfer phase, which promoted the use of fluency in a variety of speaking situations, and (3) the maintenance phase, the purpose of which was to instill fluent speech for long periods of time following release from the clinic. Reportedly, an average of 9.2 stuttered words per minute was demonstrated by the original 50 subjects at the initiation of the program. However, 30 of the subjects advanced to the maintenance phase and exhibited only one dysfluency per 10 minutes of speaking.

Theoretical Explanations

Three major theoretical explanations have emerged as attempts to explain the ameliorative effects of rhythmic stimulation, masking and DAF upon the fluency problems of stutterers.

Although, to date, the etiology of stuttering has not been determined, each of these hypotheses allude to causative factors.

Distraction Hypothesis

The ability of auditory stimulation to create a distraction has often been cited as the reason for improved fluency under such conditions. With reference to rhythmic stimulation, Barber (1940) reported that all but one of twelve rhythmic conditions served to reduce stuttering frequency. From this, he concluded that auditory stimuli caused the stutterer to refocus his attention on an external condition. This realignment of attention allegedly takes a stutterer's mind off of the act of speaking, a condition which causes the reduced stuttering. Implicit in such a suggestion is the assumption that stuttering is caused by an overmonitoring of the speech act.

More recently, the distraction theory as related to rhythmic stimulation has come under attack. Fransella and Beech (1967) compared stuttering frequency under conditions of arrhythmic pacing, rhythmic pacing, and no pacing. They theorized that if the metronome acted as a distraction, stuttering frequency should decrease under both rhythmic and arrhythmic conditions. Their results confirmed that rhythmic stimulation succeeded in reducing stuttering frequency, whereas arrhythmic stimulation did not. They conclude from their findings that it is untenable to conceptualize the metronome as a distractor. These findings were supported by more

recent replications of the original 1967 study (Fransella, 1967; Beech, 1969).

With reference to high intensity masking noise, Shane (1955) provided additional reasoning to support the distraction hypothesis. She contended that the reduction in dysfluency experienced by 25 stutterers under 95dB of masking noise was not due to the noise per se acting as a distraction. Rather, she credited the reduction to the fact that the subjects could not hear the sound of their own voices and were therefore free from the anxiety producing cues of hearing their own dysfluent speech. Wingate (1970) attributes the reduction in stuttering that occurs under conditions of masking to the tendency for the subject to speak louder. Adams and Moore (1972) reported that 12 stutterers did exhibit an increase in vocal intensity under masking noise of not less than 90dB sensation level (p. 573). However, the subjects showed no significant change in palmar sweat anxiety under the masking condition as compared to the control (quiet) condition. Also, the majority of the subjects stated that they were able to hear themselves stutter above the masking noise. Adams and Moore conclude, in agreement with Wingate but in opposition to Shane, that "the modified vocalization model is superior to the reduced anxiety explanation of the masking effect" (p. 577).

The distraction theory has not often been cited in the literature as being an explanation of the effects of DAF. However, it is of interest to note that Bloodstein (1969)

does discuss delayed auditory feedback in a distraction framework.

Vocalization Hypothesis

Wingate has provided an alternate explanation of the effects of auditory stimulation on fluency behavior. He credited the increase in intensity of the stutterer's voice, during conditions of masking, to be related in some way to increased fluency. He suggested further that increased vocal intensity, commonly referred to as the Lombard effect (Lane and Tranel, 1971), also occurs in stutterers subjected to delayed auditory feedback. In an effort to test this hypothesis, Adams and Moore (1972) reported that the reading time of 12 stutterers speaking in the presence of a 95dB masking noise and in quiet did not differ to a significant degree between conditions. However, the subjects did experience a decrease in stuttering frequency and also an increase in vocal intensity during the masking condition. A direct correlation was reported between stuttering frequency and reading duration. It was found that in the quiet condition, the higher the subject's frequency of stuttering, the longer his reading duration for that condition. Essentially the same findings were reported by Adams and Hutchinson (1974) who subjected 16 stutterers to masking levels of 10, 50, and 90 dB of white noise. Each subject also participated in a quiet condition. They reported an inverse relationship between vocal intensity accompanying increased masking levels

and stuttering frequency. It was their conclusion that the modified vocalization model is the best available explanation of the effects of masking (p. 687).

Conture (1974) provided further information concerning the effects of auditory masking by presenting both high and low intensity levels at different band filtering conditions (low-pass, high-pass, and broad-band). He determined that the increase in vocalization that stutterers experience under masking was due to the intensity of the noise rather than the frequency spectrum. Conture concluded that the relationship between changes in vocal level and changes in stuttering did not necessarily prove that increases in fluency among stutterers were the direct result of increases in vocal intensity. He stated that the relationship between the changes in stuttering and vocalization was unclear. However, he believed his results demonstrated that stutterers changed other aspects of their speaking behavior besides stuttering when subjected to noise stimuli.

Timing Hypothesis

A final theoretical explanation, related primarily to the pacing phenomenon, might be called a "timing" hypothesis. Such a position suggests that the ameliorative effect of rhythmic stimulation is the direct result of some type of temporal reorganization of the motor speech act. This view was supported by Van Riper's suggestion that the stutterer experiences a mistiming in the programming of the muscles

used for speech, the result of which is the production of a core stuttering behavior (1971, p. 404). Similarly, Conture and Metz (1974) suggested that rhythm may produce amelioration of the problem the stutterer has in the use of the systems of respiration and articulation. Specifically, they contended that:

> ...if it is appropriate to consider stuttering to be a temporal disturbance in the "unity of motor patterning" (Van Riper, 1971), then it may also be appropriate to consider that this "temporal disturbance" can be improved by conditions (e.g. rhythmic stimulation, singing, etc.) that provide the timing control necessary to produce temporally-synchronized "forward moving" speech (p. 9).

Bloodstein (1972) suggested that the beneficial effect of DAF on stuttering may also be explained, in part, by the timing hypothesis. He reasoned that the fluency stutterers experience under DAF is largely due to the simplification of motor planning resulting from the use of reduced speech rate (p. 495).

Molecular Analysis

Proponents of the above theories have implied that the components of stuttering will respond to auditory stimulation in a unitary fashion. Accordingly, all dysfluency types are assumed to obey the same laws of behavior which govern their reduction during conditions of external auditory stimulation. However, Conture (1975) has provided an alternate explanation. He indicated that different dysfluency types may obey different laws of acquisition as well as respond differently to certain external stimuli. For example, Conture suggested

that masking noise may be particularly effective for reducing part-word repetitions. If this suggestion is accurate, research on the effects of external stimuli must involve a molecular analysis of dysfluency rather than gross molar frequency counts.

Considerable research concerning strategies for molecular analysis has recently appeared in the literature. Prins and Lohr (1972), using 23 adult male stutterers, compared visual behaviors with selected vocal characteristics, via the use of a motion picture camera. From their results, they suggested that factorial analysis of dysfluencies might be useful in the classification of stutterers. This type of classification might lead to the identification of various syndromes of stuttering and provide important implications concerning stuttering etiology and therapy (p. 70).

Similarly, via the use of sound motion pictures, Webster and Brutten (1972) determined that stuttering behaviors could be categorized into primary and secondary symptoms. Their results "demonstrated that molar measures of behavior can indeed mask the course of molecular behavioral element" (p. 559), a suggestion which should alert experimenters, theorists and clinicians to the fact that attention to specific dysfluency types of stutterers is critical.

A group of graduate students were trained by Hood and Stigora (1972) to exhibit specific dysfluency types and secondary stuttering behaviors. Video tapes of these

participants were shown to groups of unsophisticated judges, who made severity ratings of stuttering based on auditory, visual and auditory-visual samples of the trained stutterers' speech. The results of the study led the researchers to conclude that "Different types of dysfluent behavior lend themselves to different modes of perception" (p. 5). Therefore, it seems that molecular analysis of dysfluency types is the avenue through which stuttering may be better understood.

Statement of the Problem

There is much controversy as to why metronome conditioning, masking, and delayed auditory feedback result in increased fluency among stutterers. Most of the research carried out to date on so-called artificial fluency techniques have mainly involved frequency counts of total stuttering moments. Although there has been a movement recently towards molecular analysis of different dysfluency types, little or no effort has been made to determine which dysfluency types are most affected by a given external auditory stimulus. This type of research might alleviate some of the controversy surrounding the effects of these techniques. In addition, if dysfluency types respond differently to external stimuli, considerable improvement in clinical management might be expected by matching dysfluency type and appropriate external stimulus for fluency-building procedures. Therefore, the purpose of the present study was to compare the effects of the

metronome, delayed auditory feedback and auditory masking on the specific dysfluency types displayed by adult stutterers.

CHAPTER TWO

METHOD

Subjects

Twelve adult stutterers, two females and ten males, ranging in age from 17 to 48 (mean age = 26.24) and stuttering severity (see Appendix C) served as subjects in the present study. One subject did not participate in the oral reading portion of the experiment because of the extreme severity of his stuttering behavior. The severity of the subjects was determined by using the Scale for Rating Severity of Stuttering (Johnson, Darley, and Spriestersbach, 1963, see Appendix A). The severity range obtained was from one to seven with a mean rating for the experimental group of 5.16. Inasmuch as the Scale for Rating Severity of Stuttering is largely based upon frequency data, a second rating was performed to assess the general severity of the actual stuttering behavior irrespective of frequency. Three experienced speech clinicians evaluated representative samples of each subject's conversational speech. The dysfluencies were rated on a seven-point scale with one being very mild and seven representing very severe (see Appendix B). The mean rating for the three judges revealed a severity range of one (very mild) to seven (very severe), with an overall severity mean of 3.3 (see Appendix C).

All subjects were categorized as secondary stutterers (word, phenome, and situational anxiety) as determined by clinical records. In addition, all subjects had normal hearing bilaterally, as determined by an audiometric screening test at 15dB HTL (re. ANSI, 1969) at the frequencies 500, 1000 and 2000 Hz.

Instrumentation

The metronome signal was furnished by an electric metronome circuit (CIRCUIT NO. 42, from RCA Solid State Hobby Circuits Manual -- REA Tech. Series HM - 19) at a signal which measured one beat per second (60 beats per minute) using a Tektronix Type 564B Storage Oscilloscope. The signal was recorded on high quality low noise tape by an Ampex AG 440B tape recorder. The high intensity masking noise was generated by an audiometer (Eckstein Brothers Audiometer, 250 MB, SERIAL NO. 961SP).

The DAF signal was set at 333 mesc of delay as measured by a Tektronix type 564B Storage Oscilloscope, via a tape recorder (Ampex, AF 440B, SERIAL NO. 0111124). This delay time was chosen on the basis of previous results relating the effects of DAF and chronological age. Since the ages of subjects varied considerably in the present study, it was reasoned that an optimal delay time would be one capable of producing expected speech alterations regardless of subject age. It was recognized that such a delay time might not produce the most dramatic effect for all subjects. In reviewing the

data of Buxton (1969), it was found that the optimal delay time for producing nonfluencies in normal talkers aged 20-26 was 200 mesc, whereas for those aged 60-80, the most disruptive delay time was 600 mesc. Consequently, since most subjects in the present study fell within the age range of 20-60, a delay time within the corresponding range of 200 to 600 mesc seemed reasonable. In addition, both Hutchinson and Burk (1973) and Ham and Steer (1967) reported that delays as great as 300 or 400 mesc were associated with the expected reduction in stuttering frequency. Therefore, the delay of 333 mesc appeared satisfactory since it was in the delay range appropriate to the ages of subjects in the present study and would, in all likelihood, produce a typical improvement in fluency.

All external stimuli were presented to the subjects at 80dB HTL through a set of earphones (TDH 39 with MX 41-AR cushions). This intensity level was chosen since it was necessary to present all of the signals at the same intensity, and 80dB has been shown to create a satisfactory masking effect (Cherry and Sayers, 1956) as well as an adequate DAF effect (Hutchinson and Burk, 1973). Subjects did not wear earphones during the control condition.

The subjects' speech was recorded on a Uher 4000 Report-L tape recorder, using a high quality microphone (Bruel & Kjäer 4145 condenser microphone coupled to A Bruel & Kjäer power supply and preamp). The recordings were made using low noise recording tape.

Experimental Recording Procedure

The subjects participated in three experimental conditions (metronome, DAF and masking) and one control condition. The auditory signal of the three experimental conditions was initially calibrated at the 80dB level with an artificial ear (Bruel & Kjäer Type 4152) at 0.5 kg pressure with a 4145 one inch pressure microphone, in conjunction with an electronic voltmenter (Bruel & Kjäer Type 2409). During the actual recording sessions, the voltage input was monitored on the voltmenter to insure that an 80dB intensity level was maintained. The calibration was rechecked periodically.

The subjects were seated in a recording booth (IAC 10-3559). The recording microphone was placed 17cm from the subjects' lips during all conditions to maintain consistency, although chosen specifically for the DAF condition. This distance was determined by Hutchinson (1971) on the basis of the speed of sound from the vocal folds to the tympanic membrane.

> The speed of sound is roughly 34,000 cm./sec., or 34 cm. in .001 sec., the time estimated to be the normal air conducted delay time from the vocal folds to the tympanic membrane (Stomsta, 1962). A constant distance of 17cm. from the vocal folds to the lips was taken into consideration (House and Stevens, 1961) and hence the 34cm. was reduced to 17cm., the final mouth-to-microphone distance (p. 12).

The conditions were presented in a randomized order (see Appendix D) and an interval of at least 24 hours existed between the four recording sessions for each subject (Jamison, 1955). The subjects were given standard instructions

(see Appendix E) and spoke extemporaneously for three minutes on one of four topics (see Appendix F), selected in a random order (see Appendix F) by the examiner. Each subject then read one of four paragraphs (see Appendix G), selected in a random order by the examiner (see Appendix G), containing 200-250 syllables. These procedures were repeated during the four recording sessions of each subject. All subjects were requested to complete a questionnaire (see Appendix H) at the termination of their final recording session. The questionnaire was designed to discover the subjects' impressions of the effectiveness of the three experimental conditions in reducing dysfluency.

Analysis of the Data

The medial 200 syllables of the 12 subjects' conversational and reading taped samples were analyzed for frequency of stuttering, by dysfluency type, using the strategy described by Hutchinson (1973). Specifically, six dysfluency patterns were identified:

1. PSR-- part-syllable repetitions including a phoneme repetition or a repetition of a CV syllable where a CVC syllable was intended.
2. WSR-- whole syllable repetitions including repetitions of one-syllable word or repetitions of single syllables within multi-syllabic words.

3. MSR-- multi-syllable repetitions including repetitions of multi-syllabic words, repetitions of two or more words in succession or two or more syllables in succession.
4. PAP-- prolonged articulatory postures including exaggerated prolongations of phonemes.
5. LA-- laryngeal abberations including audible disturbances at the level of the larynx.
6. I-- interjections including any extraneous vocalizations such as "uh", "er" and "um."

The examiner determined inter-judge reliability between herself and an experienced speech pathologist in categorizing dysfluencies according to the aforementioned strategy. A total of 1125 blocks were rated by the judges as to frequency and dysfluency type. The total number of disagreements was 114, a finding which yielded an inter-judge reliability score of .90. The examiner also compared her own ratings on successive trials of a total number of 1047 blocks, with a disagreement score of 83, a finding which yielded an intra-judge reliability score of .92.

The data obtained in the oral reading and spontaneous speech aspects of this experiment were submitted to separate two-way analyses of variance (experimental conditions X dysfluency type). Where significant F ratios were observed, Newman-Keuls post hoc procedures were employed to determine more specifically where significant variations resulted (Winer, 1971).

CHAPTER THREE

RESULTS

The results of this investigation will be presented in five sections. In the first section, the results obtained from the conversational speech of 12 adult stutterers will be presented. In the second section, the results of the oral reading samples of 11 adult stutterers will be reported. The third section will contain the profiles of individual dysfluency types obtained during conversational speech and oral reading. The fourth section will contain a comparison of the conversational speech and oral reading data. In the fifth section, the results of the subjects' rating of the effectiveness of the artificial fluency conditions will be presented. The sixth section will contain a summary of the results obtained in the present study.

Conversational Speech

The results of the conversational speech experiment are presented in Table 1. Inspection of this table reveals that all experimental conditions were associated with a reduction in stuttering frequency. However, the magnitude of this reduction was quite small for the masking condition. With the exception of part-syllable repetitions and prolonged articulatory postures in the masking condition and laryngeal

aberrations in the metronome condition, all dysfluency types were reduced in frequency for the three experimental conditions.

Table 1. Total stuttering frequency by dysfluency type per 200 syllables during conversational speech for the control and artificial fluency conditions.

Dysfluency Type	Control	Experimental Conditions DAF	MASK	MET	TOTAL
PSR	130	149	139	75	489
WSR	105	48	100	15	268
MSR	19	11	14	3	47
PAP	67	63	96	33	259
LA	79	135	69	93	376
I	97	46	75	40	258
TOTAL	497	448	493	259	1697

PSR = part-syllable repetition
WSR = whole-syllable repetition
MSR = multi-syllable repetition
PAP = prolonged articulatory posture
LA = laryngeal aberration
I = interjection

The most apparent reduction total was observed for the metronome condition.

The conversational speech data were submitted to a two factor analysis of variance with repeated measures on the latter factor (Winer, 1971). However, the within cell variance was so great that the underlying assumption of homogeneity of the variance-covariance matrix was violated.

Therefore, an appropriate square root transformation of the original data was performed to restore homogeneity (case I, page 399, $Xij = \sqrt{Xij} + \sqrt{Xij + 1}$, Winer, 1971). The results of this analysis of variance are shown in Table 2. Inspection of this table reveals the dysfluency type factor to be significant ($p = .01$) as well as the experimental condition factor ($p = .05$). Since the latter main affect was of primary importance in the present study, it was further analyzed using a Newman-Keuls post hoc probing procedure to determine between which experimental conditions significant differences occurred (Winer, 1971). The results of this procedure identified the metronome to be the only condition which demonstrated a significant decrease in dysfluencies when compared to the other conditions. All other comparisons failed to reach statistical significance.

Table 2. Analysis of variance summary table for the conversational speech data.

SOURCE	SS	df	MS	F
A (Dys. Type)	276.10	5	55.22	6.16**
B (Exp. Cond.)	96.99	3	32.33	3.87*
AB	96.45	15	6.38	.76
Within Cell	2204.07	264	8.35	
TOTAL	2672.51	287		

* $p \leq .05$
** $p \leq .01$

Oral Reading

The results of the oral reading experiment are presented in Table 3. Inspection of this table reveals that all experimental conditions were associated with a reduction in stuttering frequency. With the exception of MSRs and LAs in the masking condition and LAs in the DAF condition, all dysfluency types were reduced in frequency for the three experimental conditions. The metronome exhibited the most apparent reduction in total dysfluencies.

The oral reading data were initially submitted to the same two-factor analysis of variance that was performed on the conversational speech data. However, the underlying assumption of homogeneity was also violated. Therefore, the same square root transformation of the original data was performed as mentioned in the Conversational Speech section of this discussion (Winer, 1971). The results of this analysis of variance are shown in Table 4. Inspection of this table reveals the dysfluency type factor to be significant ($p = .01$) as was the experimental condition ($p = .05$). Again, the latter main affect was of primary importance and was further analyzed using a Newman-Keuls post hoc probing procedure to determine between which experimental conditions significant differences occurred. The results of this procedure distinguished the metronome, masking and DAF conditions to be significantly lower in total dysfluencies than the control condition during oral reading. Furthermore, the metronome

Table 3. Total stuttering frequency by dysfluency type per 200 syllables during oral reading for the control and artificial fluency conditions.

Dysfluency Type	Control	Experimental Conditions DAF	MASK	MET	TOTAL
PSR	52	44	24	15	135
WSR	22	9	18	1	50
MSR	12	8	13	2	35
PAP	65	34	60	14	173
LA	35	36	40	32	143
I	0	0	0	0	0
TOTAL	186	131	155	64	536

PSR = part syllable repetition
WSR = whole syllable repetition
MSR = multi-syllable repetition
PAP = prolonged articulatory posture
LA = laryngeal aberration
I = interjection

Table 4. Analysis of variance summary table for the oral reading data.

SOURCE	SS	df	MS	F
A (Dys. Type)	167.24	5	33.45	10.62**
B (Exp. Cond.)	45.24	3	15.08	4.787*
AB	28.46	15	1.90	.60
Within Cell	756.32	240	3.15	
TOTAL	997.26	263		

* $p \leq .05$
** $p \leq .01$

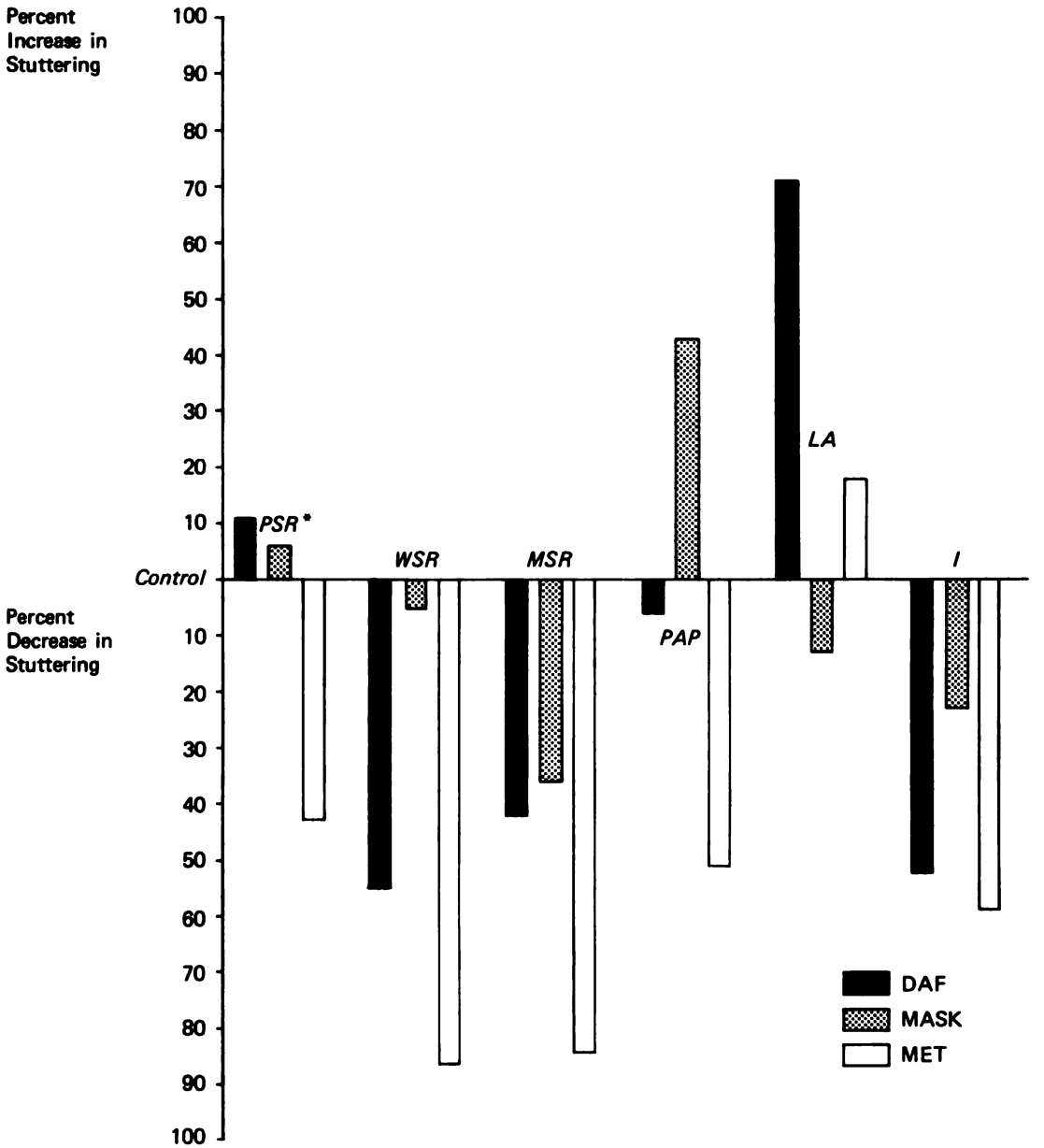
condition yielded significantly fewer dysfluencies than did the masking and DAF conditions. Masking and DAF did not show a significant difference from each other.

Individual Dysfluency Type Profiles

The six stuttering types (PSR, WSR, PAP, LA, and I) were further analyzed to determine unique influences of the artificial fluency conditions. Using the control condition as a reference, analysis was made to determine the direction and magnitude of change in stuttering frequency as a function of artificial fluency conditions. The difference between the total number of individual dysfluency types occurring under the DAF, masking and metronome conditions was calculated into a percentage of the total of the corresponding dysfluency type under the control condition. The resulting proportion represented either a reduction or an increase in dysfluency under each condition as compared to the control.

Figure 1 presents the conversational speech results of this analysis. Inspection of this figure reveals that part-syllable repetitions demonstrated a 42% decrease in frequency under the metronome condition when compared to the control condition. A slight increase in PSRs was observed for the DAF and masking conditions. Whole syllable repetitions exhibited a reduction in frequency across the three experimental conditions when compared to the control. Under the metronome condition, WSRs demonstrated an 86% reduction in frequency,

Figure 1. Percentage change in frequency from control of dysfluency types by artificial fluency conditions during conversational speech.

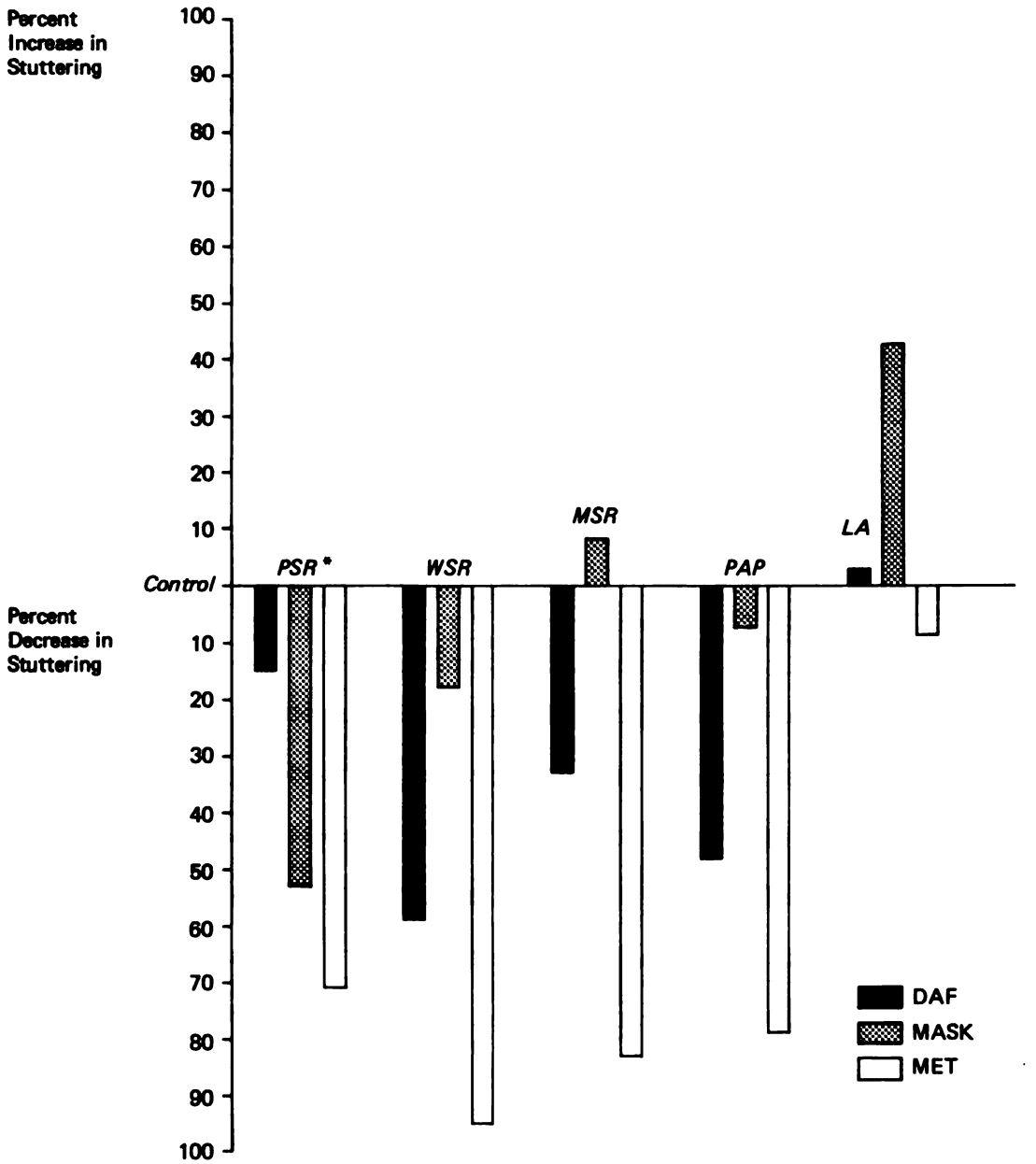


*Dysfluency type

a 54% reduction under the DAF condition, and a 5% reduction under masking. Multi-syllable repetitions were reduced in frequency across all conditions as compared to the control. However, the 86% reduction of MSRs under the metronome condition was most apparent, followed by 42% under DAF and 36% under masking. Prolonged articulatory postures demonstrated a slight reduction of 6% under DAF while showing a 51% reduction in frequency under the metronome condition. However, during masking, PAPs evidenced a 43% increase in frequency of occurrence. Laryngeal aberrations exhibited a slight increase of 18% in the metronome condition, whereas a 71% increase was observed in the DAF condition. A 13% reduction of LAs from the control condition occurred under the masking condition. Interjections reduced in frequency across all conditions as compared to the control, demonstrating reductions of 59% under metronome, 52% under DAF and 23% under the masking condition.

The five dysfluency types that occurred during oral reading (interjections did not occur) were submitted to the same analysis as were the dysfluency types in conversational speech. Figure 2 presents the percentage change in frequency of stuttering for all dysfluency types by experimental condition. Inspection of this figure shows a reduction in part-syllable repetitions across the experimental conditions, with masking and metronome demonstrating the largest reductions of 53% and 71%, respectively. Whole syllable repetitions also reduced in frequency across conditions, showing

Figure 2. Percentage change in frequency from control of dysfluency types by artificial fluency conditions during oral reading.



*Dysfluency type

a 59% reduction under DAF and a 95% reduction under the metronome condition. Multi-syllable repetitions decreased by 33% in the Daf condition and by 83% in the metronome condition. A slight increase in MSRs occurred during masking. Prolonged articulatory posutres decreased in frequency across conditions, showing a 78% reduction under the metronome condition, a 48% reduction under DAF, and a 8% reduction under masking. Laryngeal aberrations increased by 43% under the masking conditions but decreased by 8% under the metronome condition. The DAF condition produced a minimal increase of 2% in the frequency of LAs.

Comparison of Conversational Speech and Oral Reading

A comparison of the results of the Newman-Keuls post hoc probing procedure performed on the data obtained from conversational speech and oral reading revealed differences between the two situations. In conversational speech, the metronome emerged as the only condition which showed a significant reduction in stuttering when compared to the other conditions. However, the DAF and masking conditions together with the metronome showed significant reductions in dysfluencies when compared to the control condition during oral reading. In addition, the metronome condition reduced dysfluencies to a significant degree when compared to all other conditions during conversation. Whereas in oral reading all experimental conditions reduced dysfluencies to a significant

degree when compared to the control condition, with the metronome yielding significantly fewer dysfluencies than the masking and D.A.F. conditions.

Inspection of Figures 1 and 2, which represent the differences of individual dysfluency types from the control condition as percentages of decreases or increases in frequency from the control, reveals differences between conversational speech and oral reading. An increase in frequency of PSRs occurred across conditions during conversation, whereas they decreased in occurrence in all conditions during oral reading. A similar pattern was demonstrated by WSRs during conversation and reading. A reduction in MSRs occurred under masking during conversation, but there was an increase in MSRs during oral reading. A greater increase in frequency occurred in LAs during conversation under DAF than during reading. Under masking, LAs decreased during conversation and increased during reading. In the metronome condition, LAs increased during conversation and decreased somewhat during reading.

Subject's Rating of Experimental Conditions

The twelve subjects who participated in the present study were requested to fill out a questionnaire (see Appendix I) upon termination of their final recording session. This questionnaire was designed to identify the artificial fluency condition which, in their opinion, was most beneficial in producing fluency, least effective in reducing stuttering, and most comfortable.

The results of this inquiry revealed the metronome condition to be most beneficial in producing fluency, as cited by 11 of the 12 subjects. The remaining subject identified the masking condition as the most beneficial. Eight of the subjects chose DAF as the condition being the least effective in producing fluency. Four subjects identified the masking condition as least effective. The metronome condition was selected by eight subjects as "the most comfortable" and four subjects chose masking as most comfortable.

Of the 11 subjects who cited the metronome as the most beneficial condition, six felt the effect was due to their slower rate of speech. Delayed auditory feedback was described by seven of the eight subjects, who chose it as being least effective, as either confusing or distracting. The explanations of the effects of masking varied among subjects. Some reported that masking created a relaxing atmosphere, some ignored it, and one subject stated that masking made him talk louder.

In summary, the perceptual impressions of the subjects tended to confirm the data obtained. That is, the metronome condition was judged most effective and, in actuality, produced the greatest decrement in dysfluency. Masking and DAF were judged the least effective, a conclusion supported by the results for conversational speech.

Summary of Results

By means of review, the results of the present study revealed the metronome to be the only condition which

produced a significant reduction in dysfluencies during conversational speech. However, during oral reading, the metronome, DAF and masking conditions showed significant decreases in dysfluencies. The metronome also demonstrated significant reductions in dysfluencies when compared to the DAF and masking conditions which, in turn, yielded no significant differences when compared to each other.

Analysis of the six different dysfluency types, as compared to the control condition, across the three experimental conditions revealed the following results:

1. Part-syllable repetitions demonstrated slight increases in frequency under DAF and masking during conversation while exhibiting reductions in frequency under DAF and masking during oral reading. The metronome reduced PSRs in both conversation and oral reading.
2. Whole syllable repetitions exhibited reductions in frequency across the experimental conditions during conversation and oral reading. The metronome yielded the largest reduction in both situations. However, masking produced a larger reduction than did DAF during conversation, whereas the reverse occurred during oral reading.
3. Multi-syllable repetitions were reduced in frequency across the experimental conditions during conversation and oral reading. In both

conversation and reading, the metronome produced the largest reduction, followed, in ranked order, by DAF and masking.

4. Prolonged articulatory postures demonstrated a large reduction under the metronome condition, followed by a small reduction under DAF during conversation. However, PAPs showed a substantial increase under the masking condition during conversation. During oral reading, PAPs reduced across conditions, with the metronome producing the greatest reduction and masking producing the smallest reduction.
5. Laryngeal aberrations increased to a large degree in frequency under DAF and exhibited a smaller increase under the metronome condition during conversation, whereas masking produced a reduction in frequency. During oral reading, LAs increased under masking and to a slight degree under DAF. However, the metronome produced a decrease in the number of LAs during oral reading.
6. Interjections were reduced in frequency across all experimental conditions during conversation, with the metronome producing the greatest reduction and masking the lowest reduction. Interjections did not occur during oral reading.

Perceptual impressions by the subjects concerning the effectiveness of the experimental conditions in improving fluency supported the data obtained. The metronome was identified as the most effective by the subjects and by the results of this study. The masking and DAF conditions were judged by subjects to be the least effective conditions, a viewpoint substantiated by the results of this study.

CHAPTER FOUR

DISCUSSION

General Discussion

As mentioned in the Introduction of this study, previous research on the effects of artificial fluency conditions on the speech of stutterers has dealt almost exclusively with gross molar frequency counts of stuttering moments. Recently, however, some attention has been given to the effects of these conditions on specific dysfluency types. Conture and Brayton (1975) studied the effects of masking on inidivdual dysfluency types. They presented hi-level masking noise to 17 adult stutterers during oral reading. The results indicated that the part-word repetition was also the most frequently occurring dysfluency in the control condition. Reportedly, the prolongation, second in frequency of occurrence, approached significance but did not achieve it statistically. The authors concluded from these results that noise will reduce the most frequently occurring dysfluency, regardless of the type of the dysfluency.

Since the present study included replication of the aforementioned investigation, a comparison of the results of each seemed to be indicated. The data obtained from

the masking condition in the present study during oral reading do not confirm Conture and Brayton's hypothesis. The most frequent dysfluency type in the control during oral reading were PAPs. However, their reduction under masking ranked third among dysfluency types. The greatest reduction occurred in PSRs which ranked second in frequency of occurrence. In conversational speech, masking produced an increase in the most frequent dysfluency type. This finding would contradict any attempts to extend Conture and Brayton's hypothesis to masking during conversational speech. In addition, in conversation the greatest reduction under masking was shown by the least frequent dysfluency type.

It has been demonstrated that Conture and Brayton's hypothesis, that is, the most frequent dysfluency type would show the greatest reduction in frequency during masking, was not confirmed in the present study. However, the question arises as to whether or not their observation would extend to other artificial fluency conditions. Reexamination of the data for oral reading, in the present study, revealed that under DAF the most frequently occurring dysfluency type (PAP) exhibited a 48% reduction as compared to a 59% reduction in WSRs which ranked fourth in frequency. Furthermore, the reduction in PAPs during DAF ranked fourth among dysfluency types. In the metronome condition, similar results were observed. The greatest reduction produced by the metronome during oral reading occurred in MSRs and WSRs which were the

least frequent dysfluency types in the control. Likewise, the DAF and metronome did not produce the greatest reductions in the most frequent dysfluency type during conversational speech. The greatest reduction under DAF was demonstrated by the second most frequent dysfluency, whereas the most frequent dysfluency increased under DAF. The greatest reduction under the metronome condition occurred in the second most frequent dysfluency type, and the most frequent dysfluency type demonstrated the least largest reduction. Therefore, in view of these results, Conture's and Brayton's hypothesis is not extensible to other artificial fluency conditions.

Theoretical Implications

In the Introduction of this study, several theoretical explanations for the effect of artificial fluency were presented. A careful review of these hypotheses leads to the conclusion that only two of the explanations possess any power in accounting for reduced stuttering. These two theories are the modified vocalization hypothesis and the timing hypothesis.

With reference to modified vocalization, Wingate (1969) suggested that auditory stimulation of the type used in this study causes a stutterer to change the pattern of vocal fold activity. These vocalization changes may be of several types including prolonged vocal fold activity such as might be observed during DAF, increased vocal intensity which would accompany masking, or a routinization and simplification of

vocal fold onset and offset patterns associated with metronome conditioning. In the case of oral reading, the results of this study would tend to support a modified vocalization hypothesis inasmuch as all artificial fluency conditions were associated with a reduction in stuttering. Hence, one might conclude that the vocalization changes accompanying these conditions were instrumental in reducing dysfluency. However, examination of the conversational data does not permit such sweeping conclusions. Neither masking nor DAF were associated with significant reductions in dysfluency. Therefore, the typical vocalization changes in these conditions were not effective in reducing stuttering. Based upon current results, therefore, the modified vocalization hypothesis can only be invoked when a stutterer reads, since fluency alterations during conversational speech were not observed.

The timing hypothesis has received attention as a theoretical explanation of the reduction in dysfluency experienced by stutterers during metronome and DAF conditions. This hypothesis suggests that the beneficial effect of rhythmic stimulation is the result of some type of temporal reorganization of the motor speech act. Van Riper (1972) contended that stutterers experience a mistiming in the programming of the speech musculature, a suggestion which supports the timing hypothesis. With reference to the present study, two of the experimental conditions (DAF and metronome) could be expected to result in a reorganization of the temporal aspects of speech. The reorganization associated with rhythmic

stimulation may be somewhat more apparent since the stutterer is forced to synchronize his speech production with a pre-set, rate controlling stimulus. However, during DAF, the changes in speech rate are far more variable depending upon the idiosynchratic responses of each stutterer to the delay condition. Accordingly, the characteristic DAF effects of prolonged syllables, prolonged voicing, and reduced speech rate may or may not be observed depending upon the individual response.

In reviewing the results of the present study, only the metronome condition was associated with a reduction in dysfluency for both oral reading and conversation. Masking and DAF did not produce significant alterations in stuttering frequency for conversational speech. These results for conversational speech might be expected in light of the timing hypothesis. First, the metronome condition typically results in the most drastic rate control changes and, consequently should induce the most apparent reductions in dysfluency. This was precisely the case in the present study. Second, masking, which typically involves no major changes in the temporal speech pattern, might produce no significant decrements in stuttering. This line of reasoning was supported by the conversational speech results in the present study. Finally DAF may or may not be expected to alter the temporal pattern of speech depending upon individual responses to the delay imposed. The results for conversational speech suggest that the DAF effects produced no significant changes in dysfluency

for the total sample of stutterers studied, though some stutterers did exhibit improvement.

In reviewing these theoretical positions in light of present data, it would appear as if the timing theory has greater credence than the modified vocalization hypothesis. It is the only position which parsimoniously accounts for both the oral reading and conversational results. It is also quite apparent from present data that conclusions based upon oral reading may substantially differ from those based upon conversational samples. This investigator would submit that conversational sampling is a much more realistic strategy for studying stuttering and that measures of oral reading should be minimized in view of the differences in cognitive and motor patterns that characterize the reading of a text.

Clinical Implications

All three artificial fluency techniques used in the present study have been employed as clinical fluency builders. To date, limited evidence has been collected in an effort to determine which procedure may be superior for therapeutic use. The results of the present study permit some preliminary conclusions regarding this issue. When considering both oral reading and conversational speech, it was clear that metronome pacing produced the most sizeable reductions in stuttering across subjects and dysfluency types.

The one exception to this powerful metronome effect concerned laryngeal disturbances during conversational speech, where an increase in this dysfluency pattern was observed. This observation may be related to the findings of Adams and Reis (1971) who documented a greater incidence of dysfluency when stutterers are required to make frequent voiceless-to-voiced transitions. In the case of syllable-timed speech, each word is produced with minimal transitions to and from surrounding words. Hence, each word typically involved voiced onset and the chances for laryngeal problems may be exacerbated with the repeated requirement of an off-to-on vocal fold adjustment.

Regardless of this observation, the metronome must be considered the best clinical fluency building procedure for stutterers exhibiting a wide range of fluency patterns. It should also be noted that neither of the other conditions (DAF or masking) was completely effective in reducing laryngeal problems. However, in view of their failure to produce significant changes in total fluency rate for conversational speech in the present study, DAF and masking must be considered less potent clinical tools. For subjects exhibiting primarily WSRs, MSRs, or Is, DAF and masking may be effective clinical procedures since these fluency types were reduced under such conditions.

Of course, it is recognized that there are documented instances where DAF has proven effective clinically. For example, the data of Ingham and Andrews (1971) and Ryan and

Van Kirk (1974) have provided evidence of effective therapy results with DAF. It cannot be disputed that DAF may produce satisfactory results when used in a conscientiously applied behavior therapy program with regular professional care. However, current data suggest that a more efficient program could be established with metronome conditioning in view of the more powerful ameliorative effects of this artificial fluency condition.

Implications for Future Research

The present study was limited primarily by the choice of a single metronome rate, DAF delay time, and masking intensity. Systematic alteration of these variables might produce somewhat different results. Therefore, further research efforts might be focused on the effects of varying metronome rate, DAF delay time, and masking intensity on specific dysfluency types.

A second consideration concerns the rather heterogeneous subject sample of this study, which varied considerably on several variables such as age, dysfluency profile and therapy experience. Future research should be aimed at assessing the effects of different artificial fluency techniques on dysfluency patterns in more homogeneous subgroups of stutterers.

Finally, nearly all research to date on the effects of artificial fluency procedures has involved subjective impressions of the frequency of stuttering. Given the

availability of several new investigative techniques for studying acoustic and physiological variables associated with speech, it might prove worthwhile to study the effects of artificial fluency using such research procedures. For example, Hutchinson (1975) has documented at least six distinct aerodynamic patterns of dysfluency. Importantly, he observed that several quite different aerodynamic patterns resulted in similar auditory perceptual correlates. This further emphasizes the need to use more sensitive investigative strategies than perceptual evaluations when studying stuttering behavior. Perhaps a given artificial fluency technique will prove particularly effective in reducing one type of aerodynamic deviation but have little effect on another.

CHAPTER FIVE

SUMMARY

Although many external stimuli have been associated with a reduction in stuttering, three principle sources of external auditory stimulation have emerged as common clinical procedures for fluency building: rhythmic stimulation, auditory masking, and delayed auditory feedback. Much research has been conducted which documents the effectiveness of each of these stimuli in reducing stuttering. Three major theoretical explanations have emerged as attempts to explain the ameliorative effects of these external auditory stimuli. The distraction hypothesis credits the reduction in stuttering to the ability of auditory stimulation to distract the stutterer's attention away from the sound of his own voice. The vocalization hypothesis cites the increase in vocal intensity of a stutterer, while experiencing high intensity auditory stimulation, as the explanation behind reduced dysfluency. The timing hypothesis views the reduction in stuttering under rhythmic stimulation to be the direct result of some type of temporal reorganization of the motor speech act.

Most research, to date, has assumed that all components of stuttering respond to auditory stimulation in a unitary

fashion. Conture (1975), however, indicated that different dysfluency types may obey different laws of acquisition, as well as respond differently to certain external stimuli. It was the purpose of this investigation, in light of Conture's suggestion, to compare the effects of the metronome, auditory masking and delayed auditory feedback on specific dysfluency types exhibited by adult stutterers.

Twelve normal hearing, adult stutterers ranging in age, from 17 to 48, and in stuttering severity served as subjects in this study. The severity of the subjects was rated according to frequency of stuttering via the Scale for Rating Severity of Stuttering. Also, three experienced speech clinicians rated each subject according to the severity of stuttering moments, rather than the frequency of stuttering moments.

Each subject participated in three experimental conditions in addition to a control condition. The metronome signal was furnished by an electric metronome circuit, at the rate of one beat per second. The signal was recorded on tape to insure a standard signal for each subject. The high intensity masking noise was generated by an audiometer. The DAF signal was set at 333 msec of delay, via a tape recorder. All auditory stimuli were presented at 80dB HTL through a set of cushioned earphones. The subjects' speech was recorded on a Uher 4000 Report L tape recorder, using a high quality condenser microphone coupled to a power supply. The recordings were made on low noise recording tapes.

During each recording session, the subjects were seated in an IAC recording booth. The conditions were presented to each subject in a random order at intervals of at least 24 hours. The subjects were given standard instructions and were asked to speak extemporaneously on one of four topics selected in a random order. In addition, each subject read one of four paragraphs, selected in a random order, containing 200 to 250 syllables. These procedures were repeated during the four recording sessions of each subject. All subjects completed a questionnaire, at the end of the fourth recording session, designed to discover their impressions of the effectiveness of each condition in reducing stuttering.

The taped speech samples were analyzed for frequency of stuttering by dysfluency type. Specifically, six dysfluency types were identified: part-syllable repetitions, whole-syllable repetitions, multi-syllable repetitions, prolonged articulatory postures, laryngeal abberations and interjections. Interjudge reliability in analyzing frequency and type of dysfluencies yielded a score of .90. Intrajudge reliability yielded a score of .92.

The data obtained in the conversational speech and oral reading portions of this investigation were submitted to separate two-way analyses of variance. Where significant F ratios were observed, Newman-Keuls post hoc procedures were employed to determine more specifically where significant variations resulted (Winer, 1971). The results of the

present study revealed the metronome to be the only condition which produced a significant reduction in dysfluencies during conversational speech. However, during oral reading, the metronome, DAF and masking conditions showed significant reductions in dysfluencies. The metronome also demonstrated significant decreases in dysfluencies when compared to the DAF and masking conditions, which, in turn, yielded no significant differences when compared to each other.

Analysis of individual dysfluency types revealed that for conversational speech, WSRs, MSRs and Is decreased in frequency regardless of experimental condition. However, PSRs, PAPs, and LAs varied in response to specific conditions. The most sizeable reductions in dysfluency were noted in the metronome condition, with the exception of LAs. For oral reading, PSRs, WSRs, and PAPs were reduced in frequency for all experimental conditions. The MSRs and LAs increased during masking as did LAs during DAF. As with conversational speech, the most significant reductions in frequency for all dysfluency types were associated with the metronome condition.

Perceptual impressions by the subjects identified the metronome as the most effective condition in improving fluency. The masking and DAF conditions were judged by subjects to be the least effective conditions. These viewpoints were substantiated by the results of this study.

Two major theoretical implications were submitted in the present study. First, the timing hypothesis was

distinguished as the only theoretical position discussed, which was supported by the results of this investigation. Neither the modified vocalization hypothesis nor the distraction hypothesis accounted for the results obtained during both conversation and oral reading. Second, conversational speech sampling of stutterers was suggested as being superior to oral reading samples of stuttered speech. The results of the two methods were not consistent across the three experimental conditions. Therefore, conclusions based on conversational speech sampling might differ to a large degree from conclusions based on oral reading sampling. However, it was proposed that conclusions based on conversational speech samples would be more realistic, in view of the differences in cognitive and motor patterns that characterize the reading of a text.

Finally, the metronome pacing condition was identified as the most effective clinical fluency builder. During both oral reading and conversational speech, the metronome condition produced the most sizeable reductions across subjects and dysfluency types. Although DAF and masking did reduce a variety of individual dysfluency types, their overall effectiveness in reducing dysfluencies was much less pronounced than that of the metronome condition.

APPENDIX A

SCALE FOR RATING SEVERITY OF STUTTERING

APPENDIX A

SCALE FOR RATING SEVERITY OF STUTTERING

0 No stuttering

1 Very mild - stuttering on less than 1 percent of words; very little tension; dysfluencies generally less than one second in duration; patterns of dysfluency simple; no apparent associated movements of body, arms, legs, or head.

2 Mild - stuttering on 1 to 2 percent of words; tension scarcely perceptible; very few, if any, dysfluencies last as long as a full second; patterns of dysfluency simple; no conspicuous associated movements of body, arms, legs, or head.

3 Mild to moderate - stuttering on about 2 to 5 percent of words; tension noticeable but not very distracting; most dysfluencies do not last longer than a full second; patterns of dysfluency mostly simple; no distracting associated movements.

4 Moderate - stuttering on about 5 to 8 percent of words; tension occasionally distracting; dysfluencies average about one second in duration; dysfluency patterns characterized by an occasional complicating sound or facial grimace; an occasional distracting associated movement.

5 Moderate to severe - stuttering on about 8 to 12 percent of words; consistently noticeable tension; dysfluencies average about 2 seconds in duration; a few distracting sounds and facial grimaces; a few distracting associated movements.

6 Severe - stuttering on about 12 to 25 percent of words; conspicuous tension; dysfluencies average 3 to 4 seconds in duration; conspicuous distracting sounds and facial grimaces; conspicuous distracting associated movements.

7 Very severe - stuttering on more than 25 percent of words; very conspicuous tension; dysfluencies average more than 4 seconds in duration; very conspicuous distracting sounds and facial grimaces; very conspicuous distracting associated movements.

APPENDIX B

SEVERITY SCALE USED BY THREE JUDGES

APPENDIX B

SEVERITY SCALE USED BY THREE JUDGES

INSTRUCTIONS TO JUDGES

The tapes you will be listening to are representative of 12 stutterers' speech patterns. Using the scale provided below, rate the speakers' stuttering severity from 1 to 7, with 1 representing very mild and 7 representing very severe. Frequency of stuttering should not be a concern in the determination of severity. Do you have any questions?

SEVERITY SCALE

SUBJECT #1 /-----/-----/-----/-----/-----/-----/
1 2 3 4 5 6 7

SUBJECT #2 /-----/-----/-----/-----/-----/-----/
1 2 3 4 5 6 7

SUBJECT #3 /-----/-----/-----/-----/-----/-----/
1 2 3 4 5 6 7

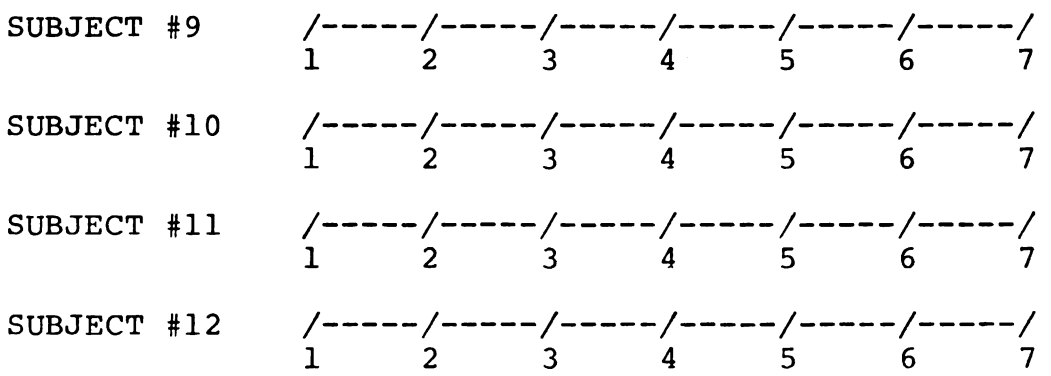
SUBJECT #4 /-----/-----/-----/-----/-----/-----/
1 2 3 4 5 6 7

SUBJECT #5 /-----/-----/-----/-----/-----/-----/
1 2 3 4 5 6 7

SUBJECT #6 /-----/-----/-----/-----/-----/-----/
1 2 3 4 5 6 7

SUBJECT #7 /-----/-----/-----/-----/-----/-----/
1 2 3 4 5 6 7

SUBJECT #8 /-----/-----/-----/-----/-----/-----/
1 2 3 4 5 6 7


SUBJECT #9
/-----/-----/-----/-----/-----/-----/
1 2 3 4 5 6 7
SUBJECT #10
/-----/-----/-----/-----/-----/-----/
1 2 3 4 5 6 7
SUBJECT #11
/-----/-----/-----/-----/-----/-----/
1 2 3 4 5 6 7
SUBJECT #12
/-----/-----/-----/-----/-----/-----/
1 2 3 4 5 6 7

APPENDIX C

SUBJECTS AND SEVERITY RATINGS

APPENDIX C

SUBJECTS AND SEVERITY RATINGS

SUBJECT	SEX	DATE OF BIRTH	SCORE: SCALE FOR RATING SEVERITY OF STUTTERING	MEAN SCORE: SEVERITY RATING OF THREE JUDGES
1.	M	5/24/56	4	2.3
2.	F	1/19/50	5	1
3.	M	10/24/28	5	3.3
4.	M	5/3/58	5	2
5.	F	10/8/55	1	1
6.	M	9/26/53	6	4
7.	M	2/1/50	7	3.3
8.	M	5/3/55	3	2.3
9.	M	10/22/49	7	7
10.	M	7/23/29	6	4.3
11.	M	4/3/49	7	7
12.	M	7/10/52	6	2

APPENDIX D

RANDOMIZATION OF EXPERIMENTAL CONDITIONS

APPENDIX D

RANDOMIZATION OF EXPERIMENTAL CONDITIONS

Subject	Session #1	Session #2	Session #3	Session #4
1.	4	2	1	3
2.	2	4	1	3
3.	1	4	3	2
4.	4	2	3	1
5.	1	2	4	3
6.	1	3	2	4
7.	4	1	3	2
8.	2	1	4	3
9.	3	4	1	2
10.	3	1	2	4
11.	2	3	1	4
12.	3	2	4	1

1 = Normal condition
2 = Metronome condition
3 = Auditory masking condition
4 = Delayed auditory feedback condition

APPENDIX E

INSTRUCTIONS TO SUBJECTS

APPENDIX E

INSTRUCTIONS TO SUBJECTS

During the first portion of this experiment, you will be asked to speak spontaneously for three minutes on a topic which I will present. You will be given 30 seconds after the topic has been given to formulate your response. At the end of that period, I will signal you to begin speaking. Try to describe the topic as completely and extensively as possible. Continue to speak until I signal you again, at which point you may stop. During the second part of this experiment, I will place a short paragraph in front of you. When I signal, begin to read the passage. Do you have any questions?

APPENDIX F

RANDOMIZATION OF TOPICS OF DISCUSSION

APPENDIX F

RANDOMIZATION OF TOPICS OF DISCUSSION

Topics of Discussion

A = Describe yourself, your job, your family and your educational history as completely as possible.

B = Describe the characters, plot and setting of your favorite book, movie or television show.

C = Describe, in detail, the events which took place on the most memorable day of your life.

D = Describe the rules, equipment and details of play of your favorite sport.

Randomization of Topics of Discussion

Subject	Session #1	Session #2	Session #3	Session #4
1.	A	D	B	C
2.	A	D	C	B
3.	D	A	C	B
4.	A	C	B	D
5.	D	C	B	A
6.	A	B	C	D
7.	C	D	A	B
8.	D	B	C	A
9.	C	B	A	D
10.	B	D	A	C
11.	D	B	A	C
12.	C	B	D	A

APPENDIX G

RANDOMIZATION OF PARAGRAPHS

APPENDIX G

RANDOMIZATION OF PARAGRAPHS

Reading Passages

Paragraph A

The common or garden mole is familiar to most people. Indeed, many persons think that they know the garden mole altogether too well, since they believe that moles do great damage to garden vegetables. As a matter of fact, the moles caught in gardens are there because they are in pursuit of worms and insects, and not to damage plants. Moles and shrews live almost exclusively on animal food, and indeed are not fitted to eat coarse vegetable material. The numbers of mice and insects eaten by them should surely entitle them to respectful consideration by farmers and gardeners. The real damage done by moles is to lawns and golf courses, where their mounds and runways are decidedly a nuisance. It is true, however, that a mole will sometimes burrow the length of a row of vegetables, causing the roots to drop and partially destroying the row of plants.

From: Bradt, G.W., and Schafer, Charles E., Michigan Wildlife Sketches, Hillsdale: Hillsdale Educational Publishers, Inc., (1971), p. 8.

Paragraph B

When a person of humble birth rises to a position of fame and fortune, his life story attracts wide attention. But even more engrossing is the history of a country that begins as an insignificant force in world affairs and develops into the most powerful of all nations. The rapid rise of the United States from a modest base to the pinnacle of power is the subject of endless comment by domestic and foreign historians. Some students of world affairs stress the importance of the geographical placement of the United States when they explain its rise to power, or they attribute American might to the exploitation of unsurpassed natural resources. But the role of the United States in world affairs has also been affected by the quality and the origin of its citizens. As immigrants flooded into this country from the Old World, American foreign policy was influenced by the newcomers. For one thing, many new citizens wanted their adopted country to intervene in the affairs of the nations they had left.

From: Fincher, Ernest B., The Government of the United States, Englewood Cliffs, N.J., Prentice Hall, Inc., (1971) p. 368.

Paragraph C

Tracks are often the only evidence of the presence of wild animals. Such tracks can provide information about their abundance, range, and habits. The majority of such animals are most active during twilight hours or at night, a principle reason why they are not seen more often. To "know" an animal is to know the location of his home, his food, his enemies, and his habits. Tracks are a record of activity and by close study an observer can become intimately acquainted with an animal without ever having seen it. Tracks of many animals are similar in appearance; for instance, the tracks of dogs, foxes, coyotes and wolves. It is a help in the identification of such tracks to know which of these animals frequent the locality in which the tracks are found. Tracks are observed after rains, as in mud along stream banks, or following light falls of wet snow.

From: Bradt, G.W., and Schafer, Charles E., Michigan Wildlife Sketches, Hillsdale: Hillsdale Educational Publishers, Inc., (1971), p. 59.

Paragraph D

William Gladstone, a famous prime minister of Great Britain, once called the Constitution of the United States "the most wonderful work ever struck off at a given time by the brain and purpose of man." The statesman had several things in mind when he offered such generous praise. As a literary work, the Constitution is notable for its brevity and its simple but distinguished language. As an instrument of government, it was unique at the time of writing because it incorporated in one short document the framework for an entire system of government. With amazing foresight, the framers of the Constitution anticipated problems and provided for them with a system flexible enough to permit change in an orderly manner. As a result, the United States has enjoyed a notable stable government, one that has surmounted crisis after crisis for almost two hundred years.

From: Fincher, Ernest B., The Government of the United States, Englewood Cliffs, N.J., Prentice-Hall, Inc., (1971) p. 368.

Randomization of Paragraphs

Subject	Session #1	Session #2	Session #3	Session #4
1.	D	C	B	A
2.	C	A	B	D
3.	A	C	D	B
4.	D	B	A	C
5.	C	D	A	B
6.	A	B	C	D
7.	D	B	C	A
8.	A	B	D	C
9.	C	B	A	D
10.	B	A	D	C
11.	D	A	C	B
12.	B	A	C	D

APPENDIX H

QUESTIONNAIRE

APPENDIX H

QUESTIONNAIRE

Name: _____

Date of Birth: _____

1. Do you believe you became more fluent in your speech while experiencing the three conditions (metronome, masking and delayed auditory feedback)?

2. Which condition was most beneficial in causing your speech to become more fluent? Why?

3. Which condition was the least effective in producing an increase in fluency? Why?

4. Which condition did you find to be the most comfortable? Please explain.

APPENDIX I

SUBJECTS' RATING OF EXPERIMENTAL CONDITIONS

APPENDIX I

SUBJECTS' RATING OF EXPERIMENTAL CONDITIONS

SUBJECT	MOST BENEFICIAL CONDITION	LEAST EFFECTIVE CONDITION	MOST COMFORTABLE CONDITION
1.	MET	DAF	MASK
2.	MET	DAF	MET
3.	MET	MASK	MET
4.	MET	DAF	MASK
5.	MET	DAF	MASK
6.	MET	DAF	MET
7.	MET	MASK	MET
8.	MET	DAF	MET
9.	MET	MASK	MET
10.	MET	MASK	MET
11.	MET	DAF	MET
12.	MASK	DAF	MASK

MET = metronome

MASK = auditory masking

DAF = delayed auditory feedback

BIBLIOGRAPHY

BIBLIOGRAPHY

Adams, M.R., and Hutchinson, J.M. The effects of three levels of auditory masking on selected vocal characteristics and the frequency of disfluency of adult stutterers. J. Speech Hearing Res., 17, 682-688 (1974).

Adams, M.R., and Moore, W.H. The effects of auditory masking on the anxiety level, frequency of disfluency, and selected vocal characteristics of stutterers. J. Speech Hearing Res., 15, 572-578 (1972).

Adams, M.R., and Reis, R. The influence of the onset of phonation on the frequency of stuttering. J. Speech Hearing Res., 14, 639-644 (1971).

Backus, O. Incidence of stuttering among the deaf. Annals of Otology, Rhinology and Laryngology, 47, 632-635 (1938).

Barber, V. Rhythm as a distraction in stuttering. J. Speech Hearing Res., 5, 29-42 (1940).

Black, J.W. The effect of delayed side tone upon vocal rate and intensity. J. Speech Dis., 16, 56-60 (1951).

Bloodstein, O. Hypothetical conditions under which stuttering is reduced or absent. J. Speech Dis., 15, 142-153 (1950).

Bloodstein, O. The anticipatory struggle hypothesis: Implications of research on the variability of stuttering. J. Speech Hearing Res., 487-499 (1972).

Bloodstein, O. A Handbook on Stuttering. National Easter Seal Society for Crippled Children and Adults (1969).

Brady, J.P. Studies on the metronome effect on stuttering. Behavior Research and Therapy, 7, 197-204 (1969).

Brady, J.P. Metronome - conditioned speech retraining for stuttering. Behavior Therapy, 2, 129-150 (1971).

Buxton, L. An investigation of sex and age differences in speech behavior under delayed auditory feedback. Unpublished Ph.D. dissertation, Ohio State University (1969).

Cherry, E. Colin, and Sayers, Bruce McA. Experiments upon the total inhibition of stammering by external control, and some clinical results. J. Psychosom. Res., I, 233-246 (1956).

Cherry, E. Colin, Sayers, B. McA., and Marland, P.M., Some experiments upon the complete suppression of stammering. Nature, 176, 874-875 (1955).

Conture, E.G. Some effects of noise on the speaking behavior of stutterers. J. Speech Hearing Res., 17, 714-723 (1974).

Conture, E.G. and Brayton, E.R. The influence of noise on stutterers' different disfluency types. J. Speech Hearing Res., 18, 381-384 (1975).

Conture, E.G., and Metz, D.E. Some effects of rhythmic stimulation on the speaking behavior of stutterers. Paper read at the 1974 Annual Convention of the New York State Speech and Hearing Association, South Fallsburgh, N.Y. (1972).

Fransella, Fay Rhythm as a distractor in the modification of stuttering. Behavior Research and Therapy, 5, 253-255 (1967).

Fransella, Fay and Beech, H.R. An experimental analysis of the speech of stutterers. Behavior Research and Therapy, 3, 195-201 (1965).

Ham, R. and Steer, M.D. Certain effects of alterations in auditory feedback. Folia Phoniat., 19, 53-62 (1967).

Hood, S.B. and Stigora, J.A. Perceptions of stuttering severity based on auditory, visual and auditory-visual cues. Paper presented at the ASHA Convention, San Francisco, (1972).

House, A.S., and Stevens, K.N. An acoustical theory of vowel production and sum of its implications. J. Acoustical Soc. of America, 4, 303-320 (1961).

Hutchinson, John, M. The differential effects of delayed and accelerated auditory feedback upon the reading performance of stutterers, clutterers and normal talkers. Unpublished M.A. Thesis, Purdue University (1971).

Hutchinson, J.M. Aerodynamic patterns of stuttered speech. In Webster, L.M. and Furst, L.C. (eds.) Vocal Tract Dynamics and dysfluency. New York: Speech and Hearing Institute, 1975.

Hutchinson, J.M. and Burk, K. An investigation of the effects of temporal alterations in auditory feedback upon stutterers and clutterers. J. of Communication Dis., 6, 193-203 (1973).

Ingham, R.J. and Andrews, G. Stuttering: The quality of fluency after treatment. J. of Communication Dis., 4, 279-288 (1971).

Jamison, Dorothy J. Spontaneous recovery of the stuttering response as a function of the time following adaptation. In Wendell Johnson (ed.), Stuttering in Children and Adults. Minneapolis: University of Minnesota Press, 1955.

Johnson, Wendell; Darley, Frederic, L.; Spriestersbach, D.C. Diagnostic Methods in Speech Pathology. Harper and Row (1952).

Lane, H. and Tranel, B. The Lombard sign and the role of hearing in speech. J. Speech and Hearing Res., 14, 677-709 (1971).

Lee, B. Artificial Stutter. J. Speech Dis., 16, 53-55 (1951).

Maraist, J. and Hutton C. Effects of auditory masking upon the speech of stutterers. J. Speech Hearing Dis., 22, 385-389 (1957).

Meyer, V. and Mair, J.M.M. A new technique to control stammering: A preliminary report. Behavior Research and Therapy, 1, 251-254 (1963).

Neelley, J.N. A study of the speech behavior of stutterers and nonstutterers under normal and delayed auditory feedback. J. Speech Hearing Dis., Monogr. Suppl., 7, 63-82 (1961).

Prins, D. and Lohr, F. Behavioral dimensions of stuttered speech. J. Speech Hearing Res., 15, 61-71 (1972).

Ryan, Bruce P. and VanKirk, Barbara The establishment, transfer, and maintenance of fluent speech in 50 stutterers using delayed auditory feedback and operant procedures. J. Speech Hearing Dis., 39, 3-10 (1974).

Shane, M.L. Effect on stuttering of alteration in auditory feedback. In Johnson, Wendell (ed.), Stuttering in Children and Adults. Minneapolis: University of Minnesota Press (1955).

Soderberg, G. Delayed auditory feedback and the speech of stutterers: A review of the studies. J. Speech Hearing Dis., 34, 20-29 (1969).

Stromsta, Courtney Delays associated with certain sidetone pathways. J. Acoustical Soc. of America., 34, 392-396 (1962).

Webster, L.M. and Brutten, Gene An audiovisual behavioral analysis of the stuttering moment. Behavior Therapy, 3, 55-560 (1972).

Winer, B.J. Statistical Principles in Experimental Design. New York: McGraw-Hill, (1971).

Wingate, M.E. Sound and pattern in "artificial" fluency. J. Speech Hearing Res., 12, 677-686 (1969).

Wingate, M.E. Effect on stuttering of changes in audition. J. Speech Hearing Res., 13, 861-873 (1970).

Van Riper, Charles The Nature of Stuttering, Englewood Cliffs, N.J.: Prentice-Hall (1971).

Yates, A.J. Empirical studies of delayed auditory feedback and stammering. Behavior Research and Therapy, 1, 96-119 (1963).