DOCUMENT RESUME

ED 070 232 EC 050 405

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TITLE An Operant Response Shaping Program for the Establishment of Fluency in Stutterers. Final Report.
INSTITUTION Hollins Coll., Va.
SPONS AGENCY Bureau of Education for the Handicapped (DHEW/OE), Washington, D.C.
BUREAU NO 56-2268
PUB DATE Jun 72
GRANT OEG-0-70-2718(607)
NOTE 80p.

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS *Behavior Change; Computer Programs; *Exceptional Child Research; Followup Studies; Operant Conditioning; Program Descriptions; Rating Scales; *Reinforcement; Speech Handicapped; *Speech Therapy; *Stuttering; Word Frequency

ABSTRACT

Reported was a 3 week fluency shaping program in which 56 stutterers (aged 8 to 59 years) were each assisted by a single speech therapist through the following program stages: very slow speech; vowels; consonant initiated syllables; one, two, and three syllable words; short, self generated sentences; spontaneous speech; and transfer. Ss also worked with a computer system which monitored speech sound characteristics and provided feedback on the accuracy of responses. Each S was described in terms of sex, age, previous treatment indication, and stuttering frequency prior to program participation. Reported were significant pre- and post-treatment differences in Ss on measures of disfluent word frequencies. A newly derived objective index of stuttering severity was said to correlate significantly with global ratings of severity made by a speech pathologist. Post-treatment measures on the Perceptions of Stuttering Inventory made on the average of 4 months after the program were found to be significantly lower than the pre-treatment measures. Followup data collected 2 years after the program showed that significant gains in speech fluency had been retained for seven out of 10 Ss. (Author/GW)

Approved BEH

EC

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The research reported herein was performed pursuant to a contract with the Office of Education, U. S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

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One of the striking characteristics of the literature on stuttering that has undoubtedly contributed to confusion in the analysis of the problem is the reliance on conceptions of stuttered speech that focus on assumptions about the phenomenon rather than on clearly observable aspects of stuttered speech. Both the clinician and the researcher have been quick to move beyond the physicalistic description of stuttering in their assessment of the problem. For example, Brutten and Shoemaker (1967) discussed stuttering in the following terms: "Stuttering is not seen as an instrumental response that depends on reinforcement for acquisition and maintenance, but as a fluency failure caused by the cognitive and motoric disorganization associated with negative emotion." (pp. 29-30). Negative emotion is the term used by these authors in reference to anxiety, fear or stress. An earlier view of stuttering was presented by Van Riper (1957, p. 879), "Stuttering, as a disorder of communication rather than of speech, always involves a disturbance in interpersonal relationships. No matter what its origin may have been, in its advanced stages, it is accompanied by fear and by compulsive stereotype reactions which its possessor can not control." As Finichel (1945) puts it, "A common denominator of all neurotic phenomena is an insufficiency of the normal control apparatus." Still in the same vein, a more recent approach to stuttering emphasizes the role properties of the stutterer. Sheehan (1968, p. 72) viewed stuttering as... "a false-role disorder. It is not a speech problem *per se*, but an interpersonal communicative disorder. It is a fault in the social presentation of the self, a self-role conflict." Many current forms of stuttering therapy emphasize the significance of emotional factors in the phenomenon of stuttering and attempt to produce results by modifying the stutterer's view of himself. (Note: It is recognized that other theories have also played a role in establishing current modes of thinking about stuttering. No attempt is being made here to omit or neglect the theories of West, Eisenson, Cherry and Sayers, or others. However, these views are not clearly representative of normative thinking in the area of stuttering. The predominant contemporary opinions of stuttering have been derived from the theories and statements of Van Riper, Johnson, Sheehan, Wischner, Shames and Sherrick, Brutten and Shoemaker, and others with stronger psychoanalytical orientations.)

A common underlying conceptual system is expressed in perhaps the majority of theories on stuttering -- stuttering involves the manifestation of an emotional condition. This particular view of stuttering represents a medical model of maladaptive behavior that has been carried over into those disciplines that deal with behavior as their subject matter. In this model, overt maladaptive behavior represent symptoms that are a function of an underlying cause; direct treatment of the symptoms neglects the real roots of the problem. And even if the symptoms are successfully altered in some way, the fundamental problem has not been solved. This particular view is expressed in the forms of stuttering therapy that have centered on the hypothesized emotional causes of stuttering and has much currency in the thinking of many speech pathologists who are practicing today. Within these therapeutic systems the direct manipulation of stuttering has often been carefully avoided, or undertaken in a limited and cautious fashion, because of the fear that other undesirable symptoms would replace the stuttering. It is instructive to note that Eysenck (1959) found little to support the viability of a concept of symptom substitution in studies which involved direct manipulation of maladaptive behaviors with the use of behavior therapy.

The widespread acceptance of the medical model in theories of stuttering has probably limited contemporary approaches to the investigation of stuttered speech. Bachrach (1965, p. 20) called attention to the concept of hypothesis myopia, "a common disease among researchers holding certain preconceived ideas that might get in the way of discovery." One manifestation of this "ideational nearsightedness" is that the sufferer fails to accept new facts which are not compatible with his views, or he effectively explains away the new facts. Both of these solutions have commonly found expression in the pronouncements of those concerned with the problem of stuttering.

A significant alternative to the medical model of maladaptive behavior is what may be called the psychological (or, even more properly, the behavioral) model. This view is succinctly stated by Ullmann and Krasner (1965, p. 20), "Maladaptive behaviors are learned behaviors, and the development and maintenance of a maladaptive behavior is no different from the development and maintenance of any other behavior." In the behavioral model, the deviant behavious *per se* are the targets for modification. The methods of treatment based on the behavioral model are derived from laboratory-derived definitions of those variables that have been demonstrated to control behavior. Behavior therapy, as this method of treatment has been designated, relies on the use of classical conditioning, operant conditioning (both appetitively and aversively motivated), extinction, satiation, and other similar procedures that involve the direct manipulation of behavior. In most forms of behavior therapy the focus is on the development of procedures for directly modifying the existing deviant behavior. Very often there is little concern evidenced with the question of how the deviant behaviors were initiated. There is no attempt made to have the subjects recall critical aspects of their childhood, nor are there attempts to have the subjects experience a "corrective emotional experience" as part of the therapeutic treatment. The dynamics of personality are not the targets for modification. During the course of behavior therapy, deviant behaviors are altered systematically, in successive approximations, until they are eliminated or replaced with more desirable behaviors.

There are sufficient data to clearly and convincingly show that stuttering enters into lawful relationships with a number of observable and manipulatible stimulus dimensions. It is unfortunate that many of these data have not been collected in a systematic fashion and that many of the phenomena involving the direct manipulation of stuttering have been used by people of questionable character who have offered short-lived panaceas to sufferers of stuttering. However, when considered from an objective point of view, many of the S-R relationships have been observed are most important --- if for no other reason than they demonstrate that there are lawful properties of stuttering that are tied to specific types of observable stimulus events. A number of stimulus conditions have been demonstrated to diminish the frequency and duration of stuttering. For example, a few of these conditions include white noise masking, delayed auditory feedback, rhythmic cueing stimuli, adaptation, punishment, and prolonged speech (see Bloodstein, 1949, 1950 for others). Continued research on the relationships between specific stimulus and response events holds much promise for future developments in our understanding of stuttering (Webster & Lubker, 1968).

A number of reports have indicated that systematic operant response shaping of prolonged speech can be useful in establishing improved fluency in stutterers. Reports by Goldiamond (1965), Ryan (1968), Soderberg (1968), and Webster (1968) stated that fluent speech could be established in even severe stutterers. Both Goldiamond and Webster pointed out that fluent speech was routinely established in less than 30 hours of training.

Recent developments in our laboratory at Hollins College have demonstrated that efficient, effective training methods can be developed for establishing fluent speech in stutterers. In order to insure the transfer of fluent speech into the stutterers every-day life and the subsequent retention of improved fluency, rather specific training procedures are required. A brief chronology of successive versions of our fluency shaping program is presented below.

Program I. The first program was conducted with two severe stutterers and was essentially a replication of Goldiamond's (1965) procedures. We found that excellent laboratory fluency was generated in both subjects. These subjects reported difficulty in maintaining a slow rate of speech outside the laboratory. Extensive sessions in the laboratory did not markedly improve their ability to employ a fluent speech pattern away from the laboratory. Nor was there a reduction in speech disfluencies in daily life when home practice included exercises involving the use of a tape recorder.

Program II. This program was a revision based on several items of information generated in our laboratory. First, we had been aware of the fact that a continuous presentation of delayed auditory feed-back was sufficient to increase speech fluency in stutterers (Webster, Schumacher and Lubker, 1970). Hence, we eliminated the contingent relationships specified by Goldiamond. Next, we chose to avoid using elaborate apparatus to control the subject's reading rates. Finally, we added a step involving rate discrimination training.

The general steps used in the second program are described below: (Each subject was advanced through the program on the basis of his progress within each step. Unless otherwise noted, subjects read from prepared texts.)

During each of the first three days, forty-minute baseline recordings of oral reading were made and disfluent words were counted. The first step in the actual program involved having the subjects re-cord each instance of a disfluent word using a hand counter. When the counts for the subject and experimenter were approximately equal, the next stage was begun.

Several variables were introduced next. The first was the continuous presentation of delayed auditory feedback. The subject wore headphones and spoke into a microphone connected to a delayed auditory feedback tape recorder set for a .2 second delay interval. At the same time, the subject was instructed to prolong his speech by markedly increasing the duration of vowel sounds. The nature of the correct responses were illustrated to the subject by the experimenter and then the subject tried prolongation until he was able to make correct responses. The subject thus began reading with very slow, prolonged speech on delayed auditory feedback. The effect of this treatment was to produce fluent speech in all subjects. Delayed auditory feedback was gradually faded out by turning down the volume control knob on the recorder. From approximately the fifth or sixth session, the subjects continued to produce self-maintained fluent speech without delayed auditory feedback. The rate of speaking was approximately 30 words per minute at this point in the program.

Our next step involved what we designated as "smoothing out" the slow speech. Smoothing was done by instructing the subject in how to decrease the speed and initial amplitude with which he made consonant sounds while maintaining prolongation of vowel sounds. Part of the instruction sequence at this point involved having the subjects learn to make gradual transitions from one speech sound to another within words. When gradual sound transitions were achieved, the speech rate of the subject was gradually increased to approximately 100 to 120 words per minute. In the event that stuttering occurred at any point in the speed-up process, the first instruction to the subject was to smooth out his sound transitions. If this instruction did not immediately improve fluency, then the speech rate was slowed. Following the recovery of fluency at the slower rate, the speech rate was increased and the program continued until speech reached a slow, normal rate (approximately 120 words per minute).

The succeeding step was labeled "rate discrimination training." This involved teaching the subject to identify and to speak at one of two different rates of speech. The subject was instructed to speak at approximately 110 words a minute for two minutes and then was switched to a rate of about 75 words a minute for a two-minute period. At two-minute intervals, a cue was given to switch from one rate to the other. After achieving reliable rate discrimination, the steps of conversation were initiated. The subject was given a magazine and told to describe in one short sentence a picture or an advertisement. The speech rate was approximately 120 words per minute. When the subject was able to describe the pictures with short sentences, then he was instructed to produce more elaborate descriptions involving longer sentences or chains of sentences. When performance at this stage of the program was stable, (i.e., no stuttering after approximately one hour of sessions) actual conversations began between the subject and the experimenter. Next, the subject was asked to use his fluent speech in conversation within the laboratory building. After a few days of conversation in the laboratory environment, the subject was asked to use his new speech pattern for short periods of time at home. He was told that if he was successful in utilizing the new fluent pattern, he was to continue using it. In the event he had any difficulty in maintaining fluent speech, he was to do one of two things: 1) either to concentrate more completely on the new speech pattern and to use it correctly; or failing that, 2) to completely give up any attempts to use the new fluent speech pattern while away from the laboratory. In general, we found that once the subjects began to use fluent speech in the home, they could extend this to other areas of conversation During the portion of the program that was concerned with transfer, training in conversation within the laboratory continued. Subjects terminated the program when they reported that they were experiencing less than approximately five instances of speech blockages during the day

All subjects (N=16) eventually succeeded in transferring fluent speech (defined here as less than a 2% disfluent word rate) to settings away from the laboratory. For some, the transition was relatively easy. For others, however, the process was very slow and unstable. After approximately ten months following completion of the program, all subjects reported that their speech was markedly improved. Most of the subjects reported that they could maintain good speech fluency; however, they reported that great concentration was required on their part and that even then they were not able to maintain good fluency at all times. Several subjects reported a recurrence of stuttering at approximately their previous levels. One of these was brought back to laboratory and run through the rate discrimination and conversation steps. He subsequently reported that his speech was improved but careful concentration was required in order to maintain fluency. The others were not able to receive additional training.

<u>Program III</u>. This version of the program was developed after a variety of attempts were made to improve upon Program II. The second program had been uniformly successful in establishing absolutely excellent speech fluency in stutterers within the laboratory. The fact that all stutterers showed substantial improvement in speech fluency outside the laboratory was also somewhat gratifying. However, the relative difficulty in attaining the use of fluent speech in settings away from the laboratory exceeded what we regarded as acceptable limits. At first, we felt that the process of transferring fluent speech into everyday speaking situations merely required constructing finer gradations of tasks in the approximation to normal speech environments. After trying changes of this type in the program, we noted little improvement in terminal performance. Other variations of the program were tried: the experimenter accompanied stutterers into speech situations outside the laboratory and delivered reinforcements for fluent speech episodes; training in relaxation was tried; further

training employing techniques of desensitization were also tested; a variety of pep talks were used; and some stutterers were even subjected to various types of punishment for instances of disfluent speech in situations outside the laboratory. Much to our dismay, none of these modifications had the desired effect of stabilizing fluent speech outside the laboratory. Finally, we considered the possibility that perhaps we had been asking the subjects to learn too many different kinds of behavior at one time.

Speech consists of chains of phonemes, syllables, words, phrases, and sentences. It occurred to us that specific desired articulatory gestures might be more readily discriminable to the subject at the level of the word or syllable than they would be when embedded in longer chains. In addition, the adequacy of vowel prolongation and gentle consonant initiation in single sounds could be detected more readily by the experimenter and this information could be relayed with increased precision to the subject as a means of aiding his learning.

In order to increase the specificity of the training, we chose to initiate Program III with single words. Individual words were presented to the subject. Instructions were given in how to prolong vowel sounds. The subject was given an opportunity to practice on successive trials, with the experimenter feeding back statements to him regarding the adequacy of his performance. Next, the gentle initiation of speech sounds was taught. After that, the subject moved progressively through a series of several hundred single words, gradually reducing the degree of prolongation to the point where the word durations were approximately the length that would occur at speech rates of approximately 100 to 130 words per minute. After achieving a stable level of performance with prolongation and gentle sound onsets, the subject began to make up two and three-word sentences from the single words. The subject moved on to construct progressively longer self-generated sentences. Conversation was phased-in in the laboratory setting, and then transferred to other locations within the building in which the laboratory was located. The fluent speech pattern was then transferred into his everyday life. We asked the subject to use fluent speech during designated periods throughout the day, and gradually extended the duration of these periods until he was reporting good speech fluency throughout the entire day. The training in the production of single words and self-generated sentences in conversation continued in the laboratory as the transfer phases were taking place.

It soon became evident that we were at last beginning to isolate some of the critical variables involved in the transfer and retention of fluent speech. A significant observation was made with the first subjects who went through this version of the program. In all cases, these subjects offered much less resistance to initiating the activities involved in transferring speech to settings outside the laboratory. The subjects did not offer excuses that would prevent them from going outside the laboratory to practice their new speech in real situations, and did not require the extensive "prodding" that had been required with some of the subjects with the earlier versions of the program. A second benefit appeared to be in the increase in certainty of the subjects' knowledge of what they were doing in order to remain fluent. It appeared to us as if the subjects were more aware of the specific articulatory gestures involved in the production of fluent speech. By increasing the specificity of what the stutterers learned in the laboratory, we were better able to insure that they could practice these new responses upon moving to new and different environments.

Program IV. The fourth edition of the fluency shaping program further increased the specification of the tasks to be learned by the stutterers. Instead of starting with a non-systematic presentation of words of different lengths, we initiated the program with one-syllable words, moved next to two-syllable words, three-syllable words, short, self-generated sentences, longer sentences, conversation, then the transfer of fluent speech to settings outside the laboratory.

In earlier versions of the program, we found that the experimenter often became a discriminative stimulus for the subject's speech fluency. Transfer of fluent speech to everyday life settings became more difficult to achieve when the experimenter served as a cue for fluent speech. A number of subjects verbalized that they could speak fluently with some degree of confidence as long as the experimenter was there to serve as a reminder of what they were supposed to do. An analysis of our procedures for feeding performance evaluations back to the subjects led us to conclude that we had inadvertently structured the learning environment in a way that interfered with the establishment of the desired terminal fluent speech behavior. Prior to beginning each section of the program, the subjects had been instructed in the form of the responses to be made. Illustrations of the responses were given to them by the experimenter and the subject was then asked to try to produce the correct behaviors. On each trial, the experimenter verbally fed back information to the subject, telling him whether or not the word had been spoken correctly, and if it had not been spoken correctly, how it was to be spoken on the next trial. The apparent flaw with this procedure was that extensive feedback of information provided a crutch on which some subjects came to rely. Thus, at this point, we decided that it would be important to reduce the participation of the experimenter in the therapeutic interaction.

Our next step was to alter the procedures for feeding back information about the adequacy of subjects' responses. We decided to reduce the continuous verbal, instructional participation of the experimenter.

Initial instructions specifying the correct responses were given and a few trials were then made by the subject, who was corrected by the experimenter. After that, feedback to the subjects in Program IV was provided through light and counter which were controlled by the experimenter and the subject. After the subject emitted the speech response, he pressed his button. If, in the experimenter's judgment, the response just emitted had met the criteria that were sought, a green light went on in front of the subject and a point was added to the counter. If the response was incorrect, nothing happened when the subject pressed his button and that trial was repeated. The introduction of the self-correction procedure and the further increase in the structure within the program once more increased the ease with which the subjects went about transferring fluency into their everyday life, and resulted in further improvements in the retention of fluency.

The findings from Programs III and IV were particularly gratifying. Each time we improved the specificity of the subject's tasks, we found that the activities involving transfer and retention of fluency were handled with greater ease. It no longer became necessary to give subjects pep talks or to deliver external reinforcements or punishers in order to have them sustain a fluent speech pattern outside the laboratory. It was becoming increasingly evident that once the subjects knew precisely what behaviors had to be produced in order to yield fluent speech, the intrinsic reinforcers for fluency would apparently sustain the activity.

Program V. The main thrust of our observations through four versions of the program had been to indicate that precision of instruction regarding small response units was probably the critical variable in determining the success or failure of the program in establishing fluency in any given stutterer. In order to learn more about what specific skills should be taught, we examined the speech sound characteristics of approximately 60 stutterers who ranged in severity from slight stuttering to very severe stuttering. In every case, when in tests the stutterer sufficiently reduced the initial intensity of speech onset below that of their stuttered speech and simultaneously increased the duration of speech sounds, disfluencies did not occur. It was clear that certain specific physical movements and certain forces were characteristic of disfluent speech in the same individuals. This information led to a rather simple, basic premise which underlies Program V: stutterers make the sounds of speech incorrectly. (At this point, we will make no attempt to infer why stutterers make speech sounds incorrectly; nor will we try to specify what proportions of speech sounds are made incorrectly, we are only reporting a generalization based on our observations.)

The fluency shaping program was now seen as a systematic means of purposefully modifying the characteristic movements and forces in the speech of stutterers. At the most parsimonious level of specification, it seemed that we were teaching three basic skills: 1) the gentle initiation of phonation (or more precisely, how to produce speech which had "correct" amplitude vs. time contours versus the "incorrect" amplitude vs. time contours of disfluent speech); 2) how to produce unvoiced consonants in such a way that the "correct" phonetory activity could occur following those sounds; and 3) how to slightly increase the duration of most speech sounds.

The fifth edition of the program was constructed during the Summer and Fall of 1969. A sequence of speech tasks was assembled which began with the acquisition of simple phonetory and articulatory skills at the level of sounds and syllables. The sounds of American English were placed into the following four functionally defined classes: Class I, vowels; Class II, vowel-like consonants (sounds represented by the letters L, R, M, N, V, J, W, Y and Z); Class III, sounds which were easy to modify in terms of duration and which were characterized by the passage of air through a constricted vocal opening prior to the onset of phonation (fricative sounds represented by the letters F, S, H, SH, CH, and the voiceless TH); and Class IV, the stop-consonants (plosive sounds represented by the letters P, B, G, K, D, and T). Our experience indicated that each class of sounds in the progression was slightly more complex and difficult to modify than the preceding class.

A series of reference sounds, or speech sound targets, was established for each step within the program. The subject had examples of correct speech sound targets presented to him prior to beginning each portion of the program. After each trial, the subject pressed a button. If, in the experimenter's judgment, the subject's response was correct, a green light flashed in fron of the subject and he then went on to the next trial. If the subject's response was incorrect, the experimenter pressed a button which prevented the signal light from coming on. The subject then repeated the trial until he got it correct several times in succession.

After completing the section containing sounds and syllables, the subject started a segment of the program which consisted of one syllable words. This portion of the program contained a sequence of words that began with Class I sounds. Words beginning with Class II sounds were next, followed by words beginning with Class III sounds and finally, words beginning with Class IV sounds. The next section of the program consisted of two-syllable words. The progression from Class I through Class IV sounds in the initial position was again used here. The next section of the program contained words with three or more syllables and again, the progression went from words starting with Class I through Class IV sounds. Throughout the sections on sounds, syllables and individual words, a variety of important sound blends was also practiced.

The duration of the one-syllable words was greatly exaggerated at the outset. With increased proficiency in attaining the gentle onset and duration speech targets, the amount of prolongation was reduced until, by the time the subjects were working with three-syllable words, they were producing words of a duration that would be associated with the speech rate of 100 to 130 words per minute. The next stage of the program involved having the subjects construct short sentences. After that, longer sentences were constructed by defining the meaning of single words. Speech rates were maintained at approximately 100-130 words per minute in conversation.

The transfer activities in this version of the program were initiated in parallel, successive stages beginning very early in the program. Subjects begin to transfer practice on single words into their home environment early in the program, to practice some limited conversation at home using an exaggerated slow speech pattern, and then as the progression through the program continued, they transferred longer and more comprehensive fluent speech behavior into their everyday lives. As the final transfer portions of the program were taking place, laboratory training on the basic skills continued.

Normal administration of Program V has ranged from 40 to 60 laboratory hours per individual. The program has been used in a lightly simplified form with children at six to eight years of age. It is intended for use with individuals over approximately the ages of 10-12. The oldest person to go through the program was 57 years of age. A total of 55 stutterers have gone through this version of the program.

We have found that the program requires a minimum of six hours per week in order to produce its effects in an efficient manner. Typical therapy sessions, one hour in duration, several times a week are spaced too far apart for significant learning to occur. In most of our cases, subjects go through an intensive three-week program, working 4 to 7 hours a day for 15 to 21 days. This type of schedule permits a dramatic, rapid improvement in speech fluency. The rapid rate of fluency acquisition is probably an important form of reinforcement that contributes to the success of the program.

The purpose of the present investigation was to provide additional data on the behavior changes induced by the participation of stutterers in the fluency shaping program.

METHOD

Subjects

A total of 56 stutterers, 47 males and 9 females participated in the research. The stutterers ranged in age from 8 to 59 years. Table 1 presents a summary of the subjects' sex, age, previous treatment indication and stuttering frequencies prior to their participation in the fluency shaping program. A history of previous treatment for stuttering was reported by 38 subjects. All subjects contacted the Fluency Shaping Program and requested the opportunity to participate. Applicants were accepted into the program in order of their dates of application.

Apparatus

The apparatus consisted of 5 Norelco Model EL3302 portable tape recorders used for collecting followup data, two Uher Model 4000 Report L tape recorders used for laboratory tape recording of all experimental sessions, and two Ampex VR-7000 video tape recording systems used for collecting before-after speech samples from the subjects. Two standard photographic timers (Gra Lab Model 170) were used to time laboratory sessions.

The computer monitoring system consisted of a Pacific Plantronics headband mounted microphone (Model Ms-40), and Amprex Model 601 tape recorder, a Digital Equipment Corporation PDP8-I with a 16 K core, a 265 K disk, and an AX-08 Laboratory Pheripheral Unit.

Procedure

All stutterers went through an initial standard speech evaluation which consisted of: 1) an interview; 2) reading a series of three standard 1000 word passages; 3) the administration of self-rating scales; and 4) a clinician's rating of stuttering severity. The interview and oral reading selections were recorded on video and audio tape. Counts of disfluencies were made from the video tapes.

After completing the speech evaluation the stutterers entered the fluency shaping program. Each stutterer was assigned to a single therapist who worked with him through the three weeks program. The stutterer moved through the fluency shaping program on the basis of his own individual performance. That is, each stutterer could work through the program as quickly as he was able. An outline of the program is presented in Table 2.

Table 1. Age, Sex, Previous Treatment Notation, and Mean Pre-treatment Stuttering Frequency for Each Subject.

Subject #	Age	Sex	Mean Percent Stuttering Before	Previous Therapy
61	12	M	2	No
62	32	M	12	Yes
65	12	M	42	Yes
66	59	M	1	Yes
67	30	M	25	Yes
69	9	M	54	No
71	23	M	14	Yes
72	14	M	12	Yes
73	24	M	17	Yes
75	25	M	5	Yes
76	41	M	18	Yes
77	22	M	30	No
78	25	F	1	No
79	28	M	20	No
80	45	M	6	No
81	25	M	50	Yes
82A	22	F	20	Yes
82B	21	M	11	Yes
83	50	F	1	Yes
84	32	M	19	Yes
85	18	F	3	No
86	45	M	4	Yes
87	9	M	8	No
88	34	M	27	Yes
92	22	M	3	Yes
93	20	F	.5	No
94	41	F	0	No
95	33	M	10	Yes
96	18	M	35	Yes
97	10	M	12	Yes
98	23	M	2	No
99	27	M	7	Yes
103	21	M	26	No
104	19	M	0	Yes
105A	18	M	7	Yes
105B	10	M	30	Yes
106	53	M	7	Yes
107	12	M	6	Yes
108	27	M	3	Yes
109	33	M	3	Yes
110	36	M	45	No
111	26	M	19	Yes
112	8	M	4	No
113	34	F	1	Yes
114	14	M	33	Yes
115	22	M	7	Yes

Table 1. (Continued)

Subject #	Age	Sex	Mean Percent Stuttering Before	Previous Therapy
116	40	M	46	Yes
117	22	M	25	Yes
118	20	M	4	Yes
119	20	M	52	Yes
120	8	M	16	Yes
121	26	M	.2	No
122	32	F	3	No
123	22	M	15	Yes
124	9	M	38	Yes
125	23	F	24	No

Table 2 Outline of the fluency shaping program.

Program Section	Responses to be acquired
1. Very slow speech	Prolongation of speech. Syllables extended to 2 sounds each. To be used only in laboratory.
2. Vowels - in isolation	Increased sound duration. Gentle initiation of voicing.
3. Consonant initiated syllables (vowel like consonants - W,R.L,M.N, etc.)	Increased consonant duration, plus increased vowel duration. Gentle onset of voicing.
4. Consonant initiated syllables (Fricatives - F, Th, S, Sh, etc.)	Reduced intra-oral pressures followed by gentle onset of succeeding vowel.
5. Consonant initiated syllables (Stop consonants - P,B,D, T, etc.)	Reduced intra-oral pressures. Soft lip and tongue contact. Gentle onset of voicing.
6. One syllable words	All above, plus smooth transitions into successive sounds. Use of slow speech in the laboratory building.
7. Two syllable words	Same as Step 6.
8. Three syllable words	Same as Step 6.
9. Short, self generated sentences	Slow speech rate (about 125 wpm), plus targets noted at Step 6.
10. Spontaneous speech	Slow, normal speech rate (about 125 wpm), plus targets noted at Step 6.
11. Transfer	Use of skills noted at Step 10 in all situations.

The daily laboratory routine consisted of from 10 to 18 twenty minute periods during which the subject worked through the program under the therapists guidance. In order to move from one stage of the program to the next, the subject had to achieve an accuracy of better than 84% for two successive twenty minute periods. The therapist kept a running record of correct vs. incorrect responses during each work period.

While Steps 2 - 10 were taking place in the laboratory, the stutterer daily practiced a half hour using slow speech in reading newspapers and magazines. As part of this practice the subjects were to transfer the skills learned in the laboratory sessions into the slowed speech. That is, if the laboratory sessions dealt with softening stop consonants, then that skill was to be practiced during the oral reading on that day.

The transfer phase of the program was different for each subject. Basically, each subject was first given the opportunity to make telephone calls to local businesses under the therapist's guidance. Next, the subject went into the community and talked to merchants, gas station personnel, or went into social settings requiring self-introduction and conversation. Tape recordings were made and checked by both the therapist and the subject. If the subject experienced any difficulties the therapist saw to it that additional laboratory practice was given in the skills which were deficient. It should be noted that the outside practice paralleling Steps 2 - 10 in the program gradually came to involve the use of slow, normal speech in connection with other people. Thus, transfer of fluency was begun early in the program.

Following the completion of the program each subject was again interviewed, given an oral reading exercise, and was then released from the program. At various intervals following completion of the program, follow up procedures were implemented. These consisted of: 1) telephone calls; 2) visits to the laboratory, whenever possible; 3) administration of self-rating forma; and 4) having the subject tape record a standard series of speech tasks.

RESULTS

Time in Program

The number of 20 minute sessions required by each subject to complete the various components of the fluency shaping program is presented in Table 3. The table presents the time actually spent in practice in the laboratory, and does not include the practice time spent by the subjects outside the laboratory.

It should be noted that the actual amount of time subjects spent in transfer activities was not possible to measure. Each subject participated in a variety of activities at times and places of his own choosing, and consequently, this portion of the program did not lend itself to quantification. The estimates of average total time in transfer sessions were arrived at by consultation between the speech pathologist and the principal investigator. The total amount of time the subjects spent in the program averaged out to approximately 50 hours. As was noted previously, the performance of the subjects determined the rate at which they moved from one portion of the program to the next. The working criterion used was that the subjects had to perform at approximately an 85% accuracy level for two successive 20 minute sessions in order to advance from one portion of the program to the next. This criterion did not seem to be unnecessarily strict, yet it was stringent enough to insure that the subjects were able to progress properly from one portion of the program to the next.

Disfluent Word Frequencies

The mean disfluent word frequencies for each of the stutterers before and then immediately after their participation in the fluency shaping program are shown in Table 4. The pre-treatment mean disfluent word percent for all subjects combined was 15.8. The post-treatment mean disfluent word percent was .9. It was noted during the administration of the program that with the introduction of the slow, slow speech in the laboratory the frequency of disfluent words was estimated to below approximately three percent. By the time most subjects were in the third step of the program, the disfluent word frequencies were generally below one percent. At the same time the so-called "secondary characteristics" which often accompany stuttering were observed to drop out. Because of this low frequency occurrance no systematic attempts were made to qualify the number of disfluencies <u>during</u> the administration of the program.

Table 3. Mean number of 20 minute sessions spent in various portions of the fluency shaping program.

Program Segment	Mean
Very slow speech	4.0
Sounds	12.4
One syllable words	16.8
Two syllable words	20.0
Three syllable words	17.7
Short self-generated sentences	18.5
Conversation	-

Average total time in laboratory sessions = 29.8 hours

Estimated average total time in transfer sessions = 20.0 hours

Approximate total average time in program 49.8 hours

Table 4. Age, Sex, Pre and Immediate Post-Treatment Stuttering Frequencies

Subject #	Age	Sex	Mean Percent Stuttering Before	Mean Percent Stuttering After
61	12	M	2	.1
62	32	M	12	.2
65	12	M	42	4
66	59	M	1	0
67	30	M	25	.2
69	9	M	54	.4
71	23	M	14	.1
72	14	M	12	.5
73	24	M	17	1
75	25	M	5	.7
76	41	M	18	2
77	22	M	30	.1
78	25	F	1	.3
79	28	M	20	.8
80	45	M	6	.2
81	25	M	50	10
82A	22	F	20	.1
82B	21	M	11	.9
83	50	F	1	.1
84	32	M	19	2
85	18	F	3	.1
86	45	M	4	0
87	9	M	8	3
88	34	M	27	.5
92	22	M	3	.2
93	20	F	.5	0
94	41	F	0	0
95	33	M	10	.9
96	18	M	35	1
97	10	M	12	.7
98	23	M	2	.2
99	27	M	7	.1
103	21	M	26	1
104	19	M	0	0
105A	18	M	7	0
105B	10	M	30	1
106	53	M	7	.3
107	12	M	6	.4
108	27	M	3	.2
109	33	M	3	.7
110	36	M	45	2
111	26	M	19	.6
112	8	M	4	0
113	34	F	1	0
114	14	M	33	0
115	22	M	7	.1

Table 4. (Continued)

Subject #	Age	Sex	Mean Percent Stuttering Before	Mean Percent Stuttering After
116	40	M	46	.8
117	22	M	25	0
118	20	M	4	.1
119	20	M	52	12.0
120	8	M	16	.5
121	26	M	.2	0
122	32	F	3	.4
123	22	M	15	.6
124	9	M	38	0
125	23	F	24	0
	Group Mean		15.8	.9

An Other Index of Stuttering Severity

It has been traditionally a rather difficult task to provide an objective definition of stuttering severity. As with any apparently multidimensional problem, an initial objective analysis must be restricted to the more salient attributes of the phenomenon being investigated. A meaningful, clinically applicable method of stuttering evaluation must be neither too complex nor too time consuming to use, yet the method must be reliable and should correlate well with general clinical impressions of stuttering desparity. It is clear that scales such as the Iowa scale rating severity of stuttering do not succeed well for the simple reason that they place together different dimensions of the stuttering problem which covary independently of each other. Consequently, the rating which is derived is at best a value which is determined to a large extent by the interpretations of the specific therapist administering the reading scale. Simple frequency measures of stuttering, while useful, seem to omit another particularly relevant dimension of the problem, the extent to which the subject experienced pauses of speech blocks.

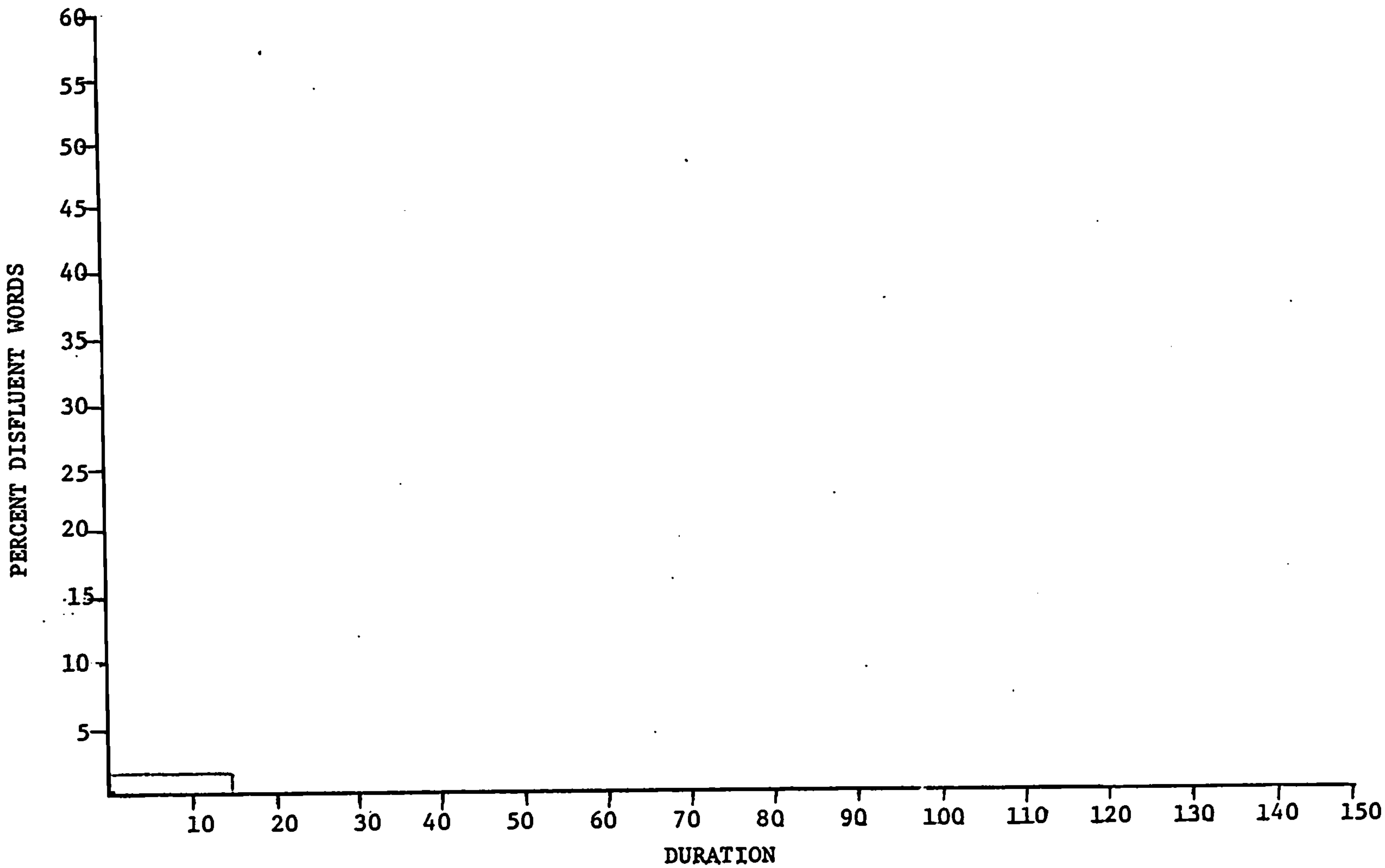
One of the methods of stuttering evaluation we have employed seems to meet the desired criteria. The method may be used with any speech sample and is not technically complex in its application. Basically, the parameters of stuttering frequency and speech block duration are sampled with standard procedures and an area function is then plotted. Figures 1 through 10 show area functions before treatment and again following treatment for ten randomly selected stutterers who completed the fluency shaping program.

A standard 1000 word reading passage was chosen for use as the speech task. The percent of words on which at least one disfluency occurred was determined. As with all such counts made during this research program, a disfluent word was scored if the subject displayed one, or more, of the following behaviors during the utterance of a word: struggle concurrance with speech initiation, silent stops, forced breathing, facial grimaces, or repetitions of sounds, syllables, or words. This measure is a sensitive response measure; the reliability of disfluent word counts by two different and independent observers has consistently ranged from 90 to 100% in our laboratory (Webster and Dorman, 1970); and the measure is convenient to use at a clinical or research setting where large quantities of data are handled.

The second dimension of the severity index consists of duration. This is a measure of speech blockage duration, i.e., the amount of time a stutterer is silent or struggling while trying to initiate a speech sound. The sampling procedure for establishing duration involved selecting on a random basis nine speech blocks from the 1000 word sample. Three speech blocks were taken from the first third of the sample, three from the second and three from the final third. Each third of the 1000 word passage was broken into ten equally spaced segments. Three of the ten segments were randomly chosen and the first

Table 5. Rank Ordering by Area Functions (Percent disfluent words x total duration of a random sample of hesitations) and Rank Ordering of Stuttering Severity of the Same Subjects by a Speech Clinician.

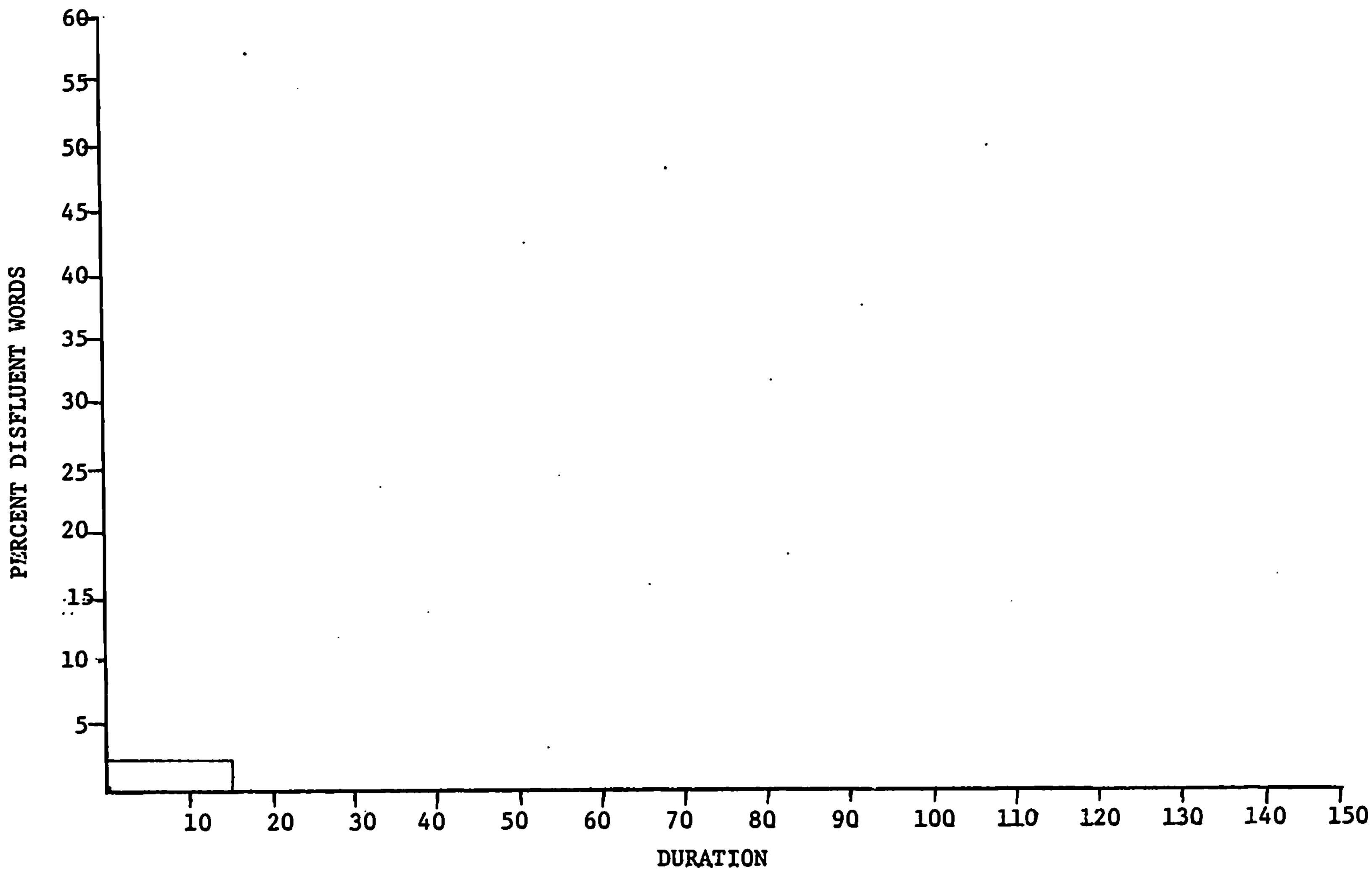
Subject No.	Ordering By Area	Ordering By Speech Clinician
83	1	1
98	2	2
106	3	3
115	4	4
105A	5	5
84	6	6
103	7	7
76	8	8
79	9	10
80	10	9
77	11	13
82B	12	12
88	13	11
81	14	14
110	15	15



Subject Number 83

Open Area = Before Treatment
Darkened Area = After Treatment

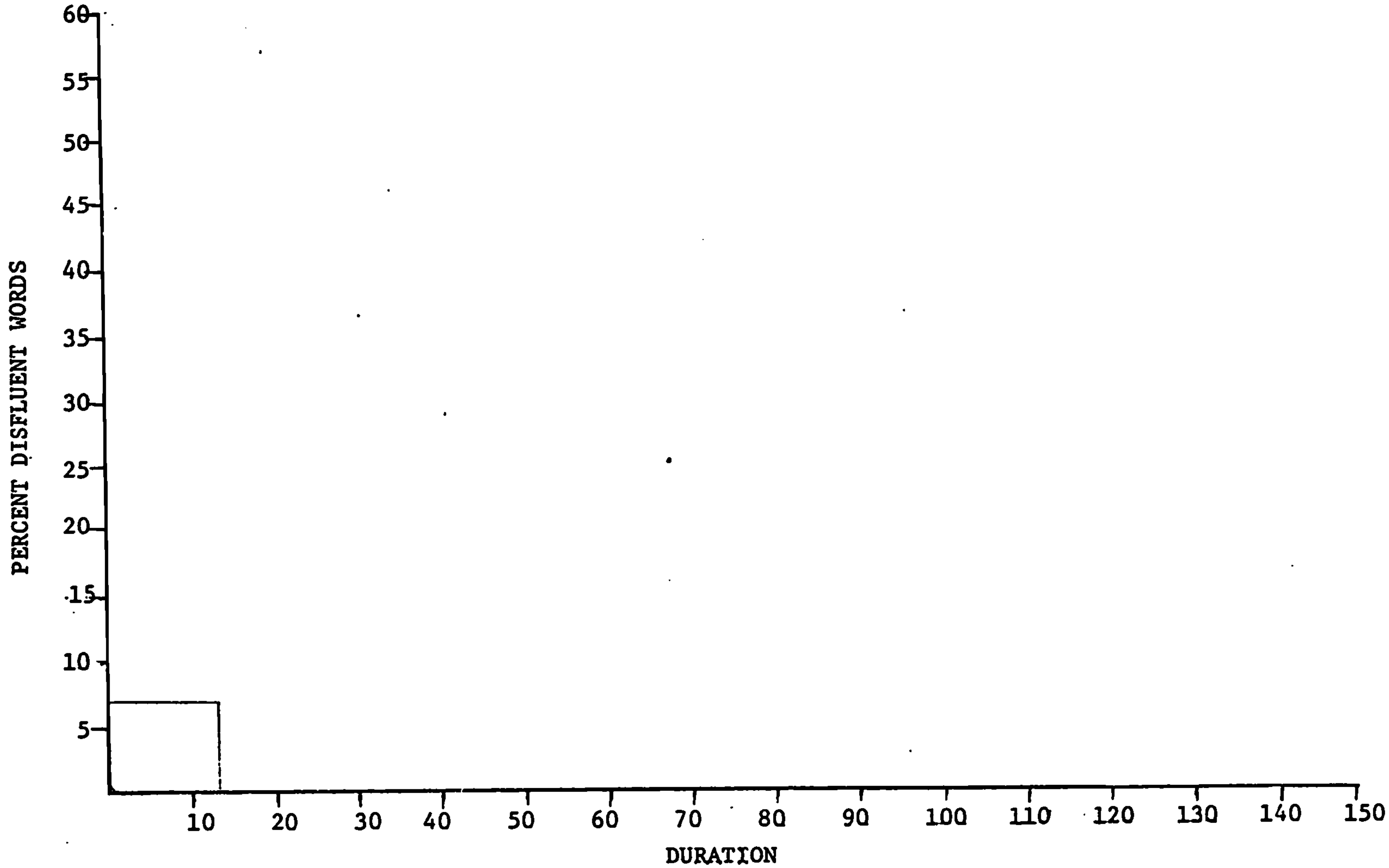
Figure 1. Area Function for Subject #83.



Subject Number 98

Open Area = Before Treatment
Darkened Area = After Treatment

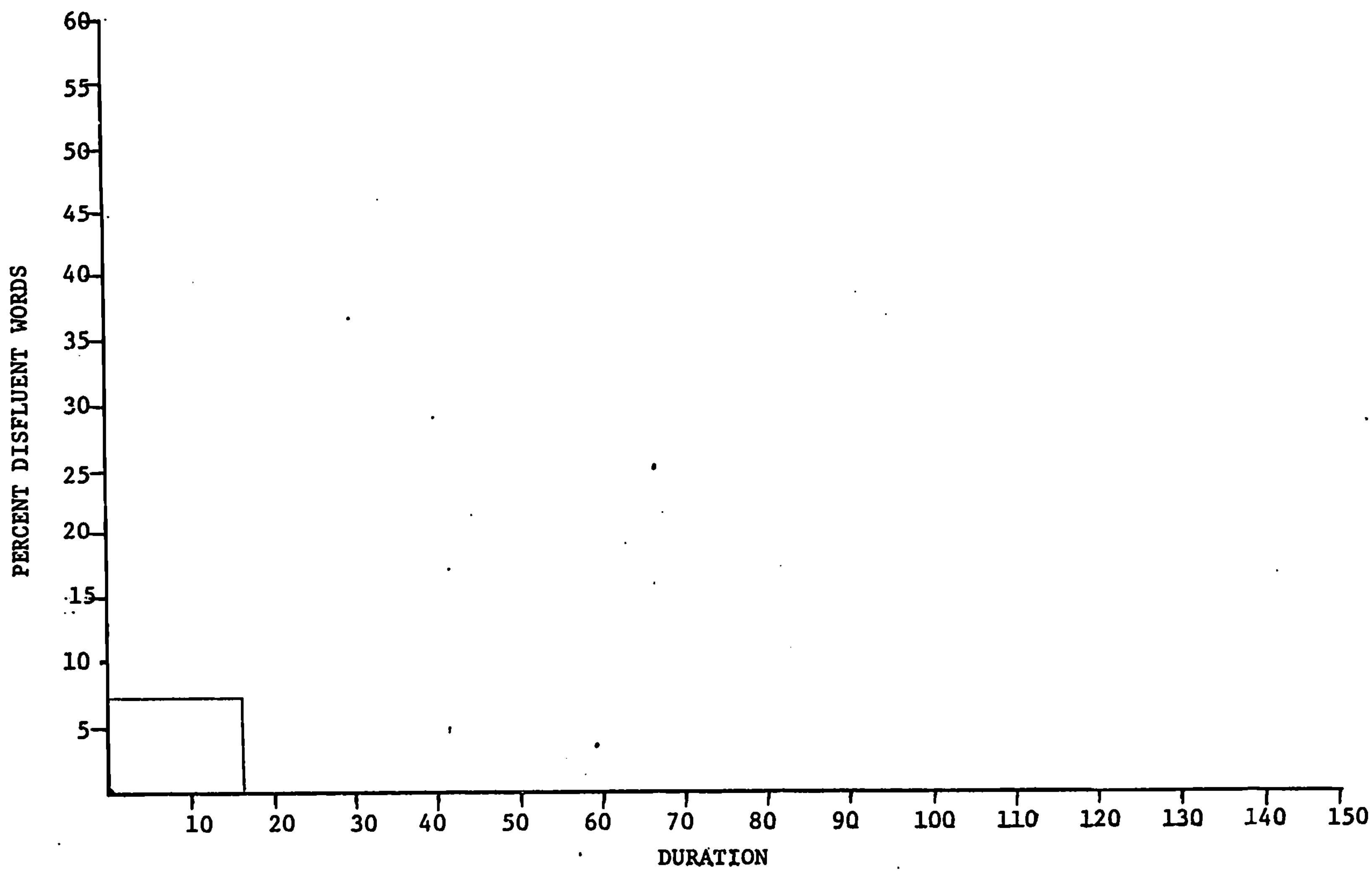
Figure 2. Area Function for Subject #98.



Subject Number 106

Open Area = Before Treatment
Darkened Area = After Treatment

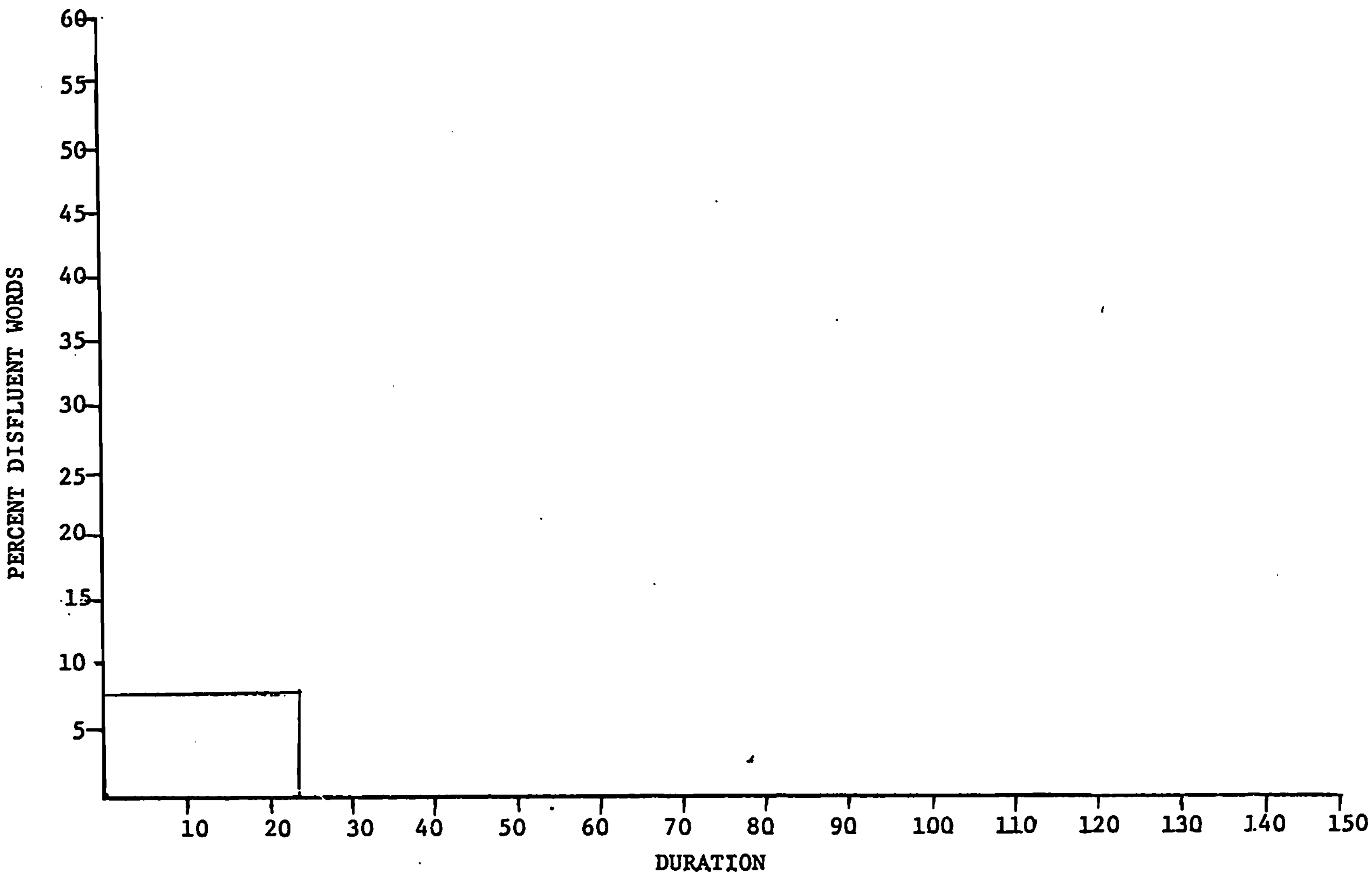
Figure 3. Area Function for Subject #106.



Subject Number 115

Open Area = Before Treatment
Darkened Area = After Treatment

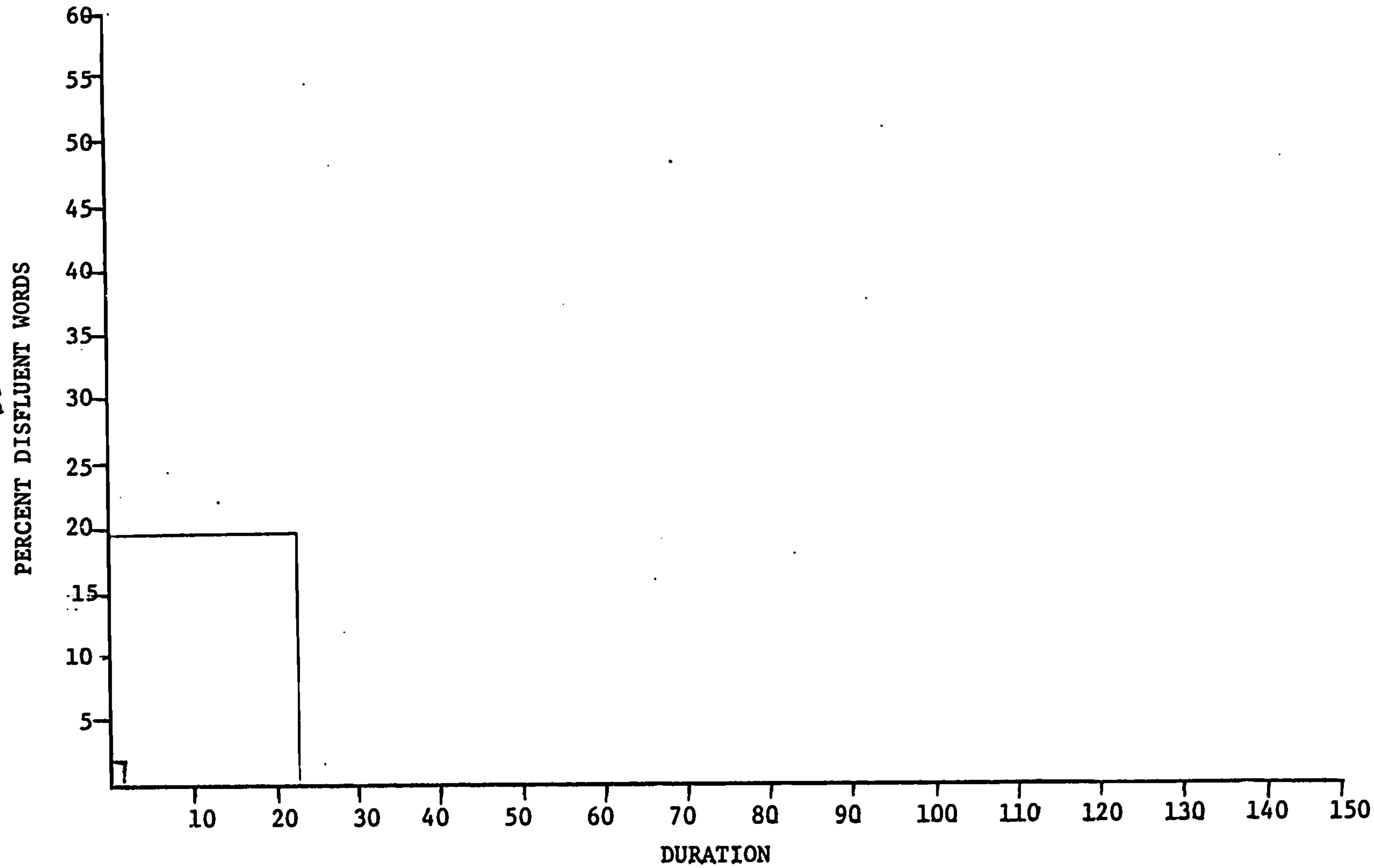
Figure 4. Area Function for Subject #115.



Subject Number 105A

Open Area = Before Treatment
Darkened Area = After Treatment

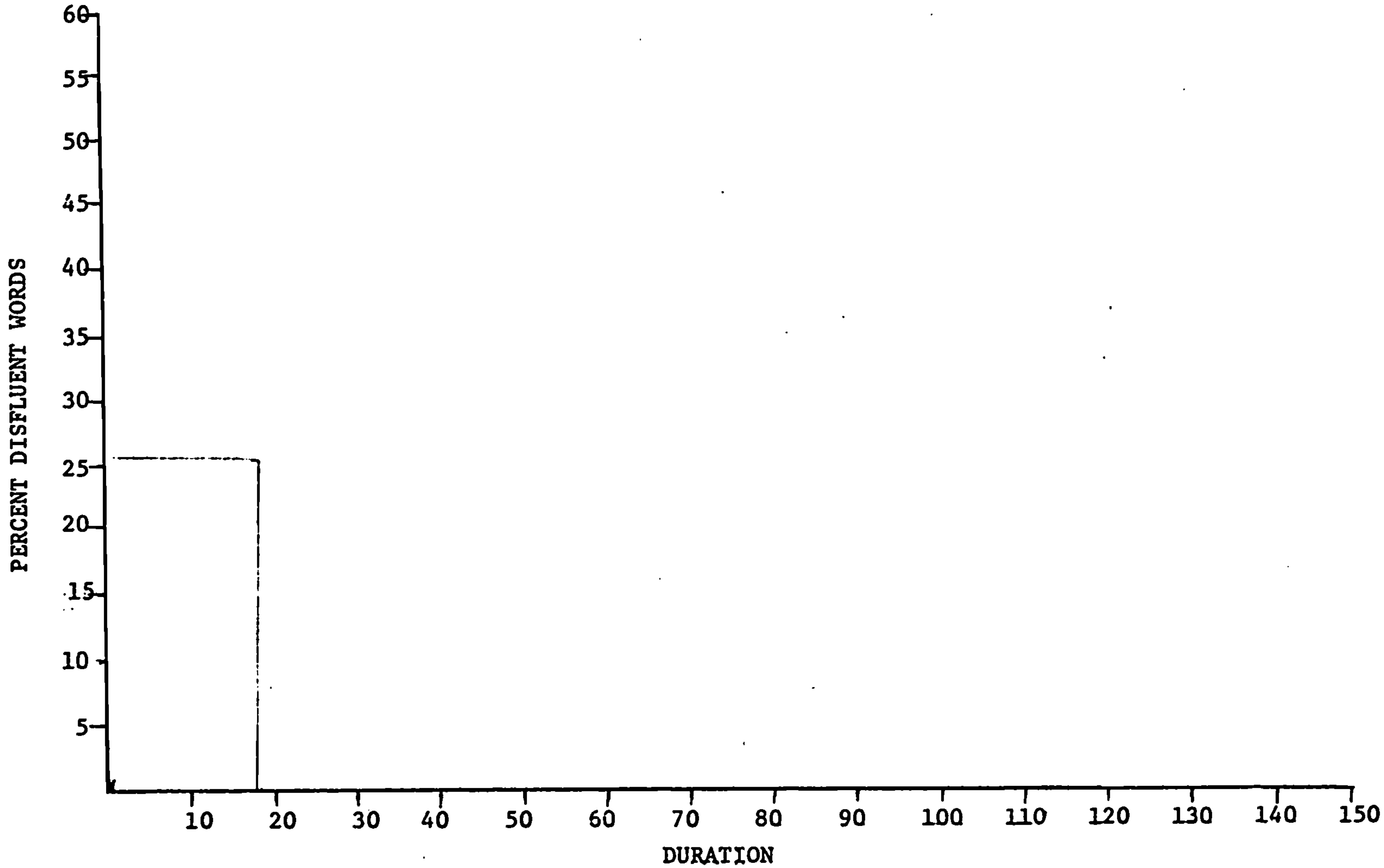
Figure 5. Area Function for Subject #105A.



Subject Number 84

Open Area = Before Treatment
Darkened Area = After Treatment

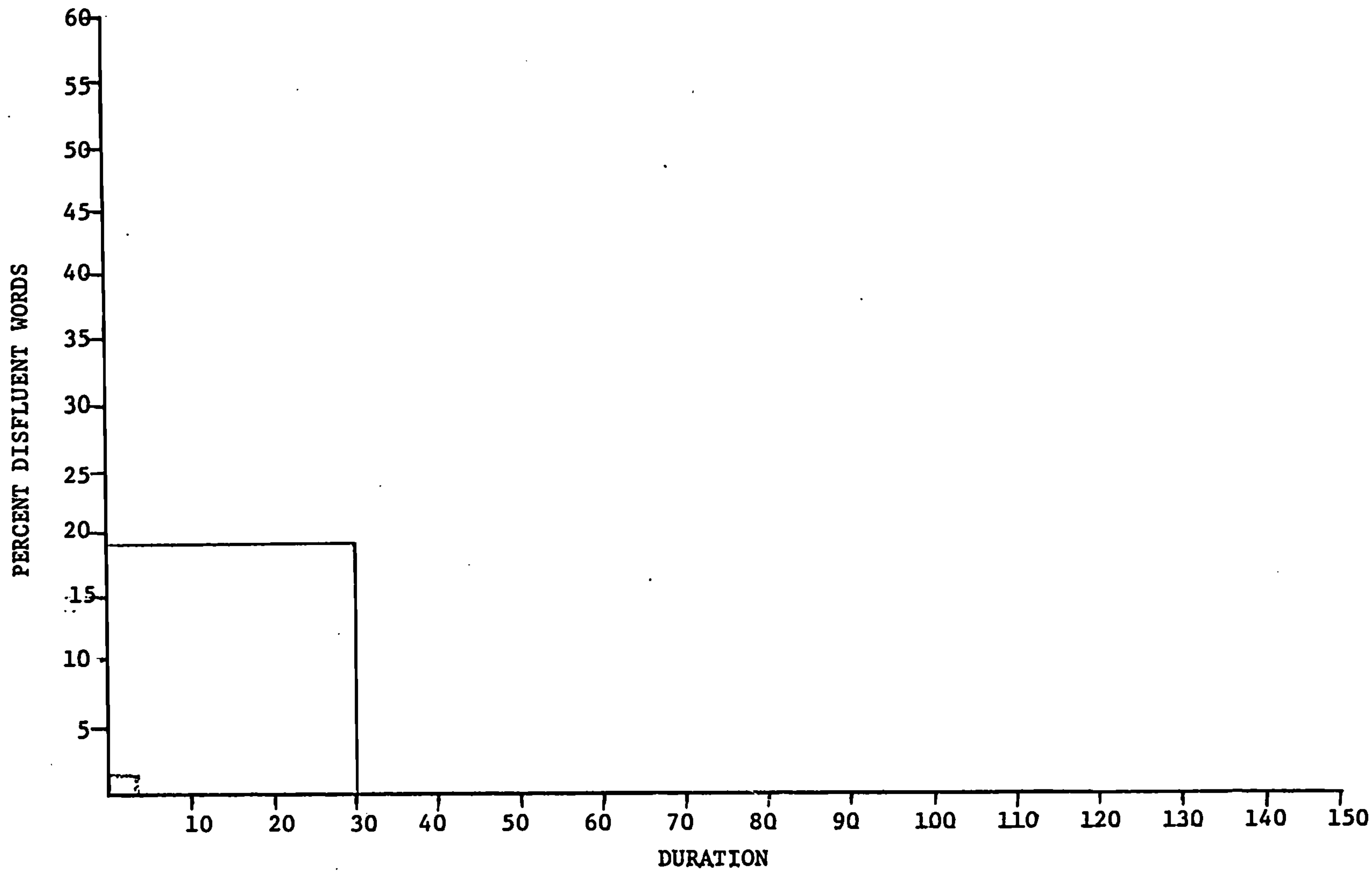
Figure 6. Area Function for Subject #84.



Subject Number 103

Open Area = Before Treatment
Darkened Area = After Treatment

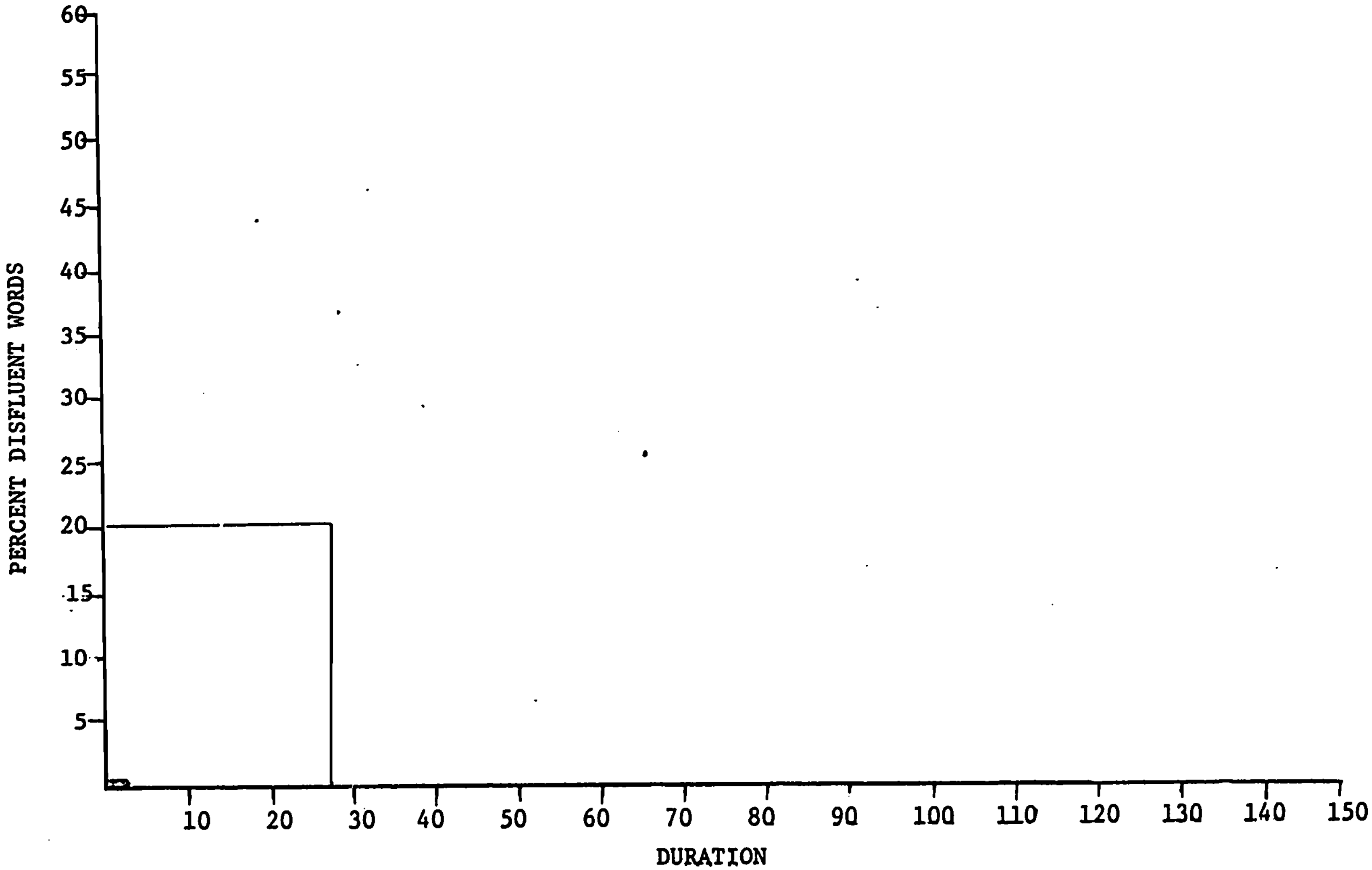
Figure 7. Area Function for Subject #103.



Subject Number 76

Open Area = Before Treatment
Darkened Area = After Treatment

Figure 8. Area Function for Subject #76.



Subject Number. 79

Open Area = Before Treatment
Darkened Area = After Treatment

Figure 9. Area Function for Subject #79.

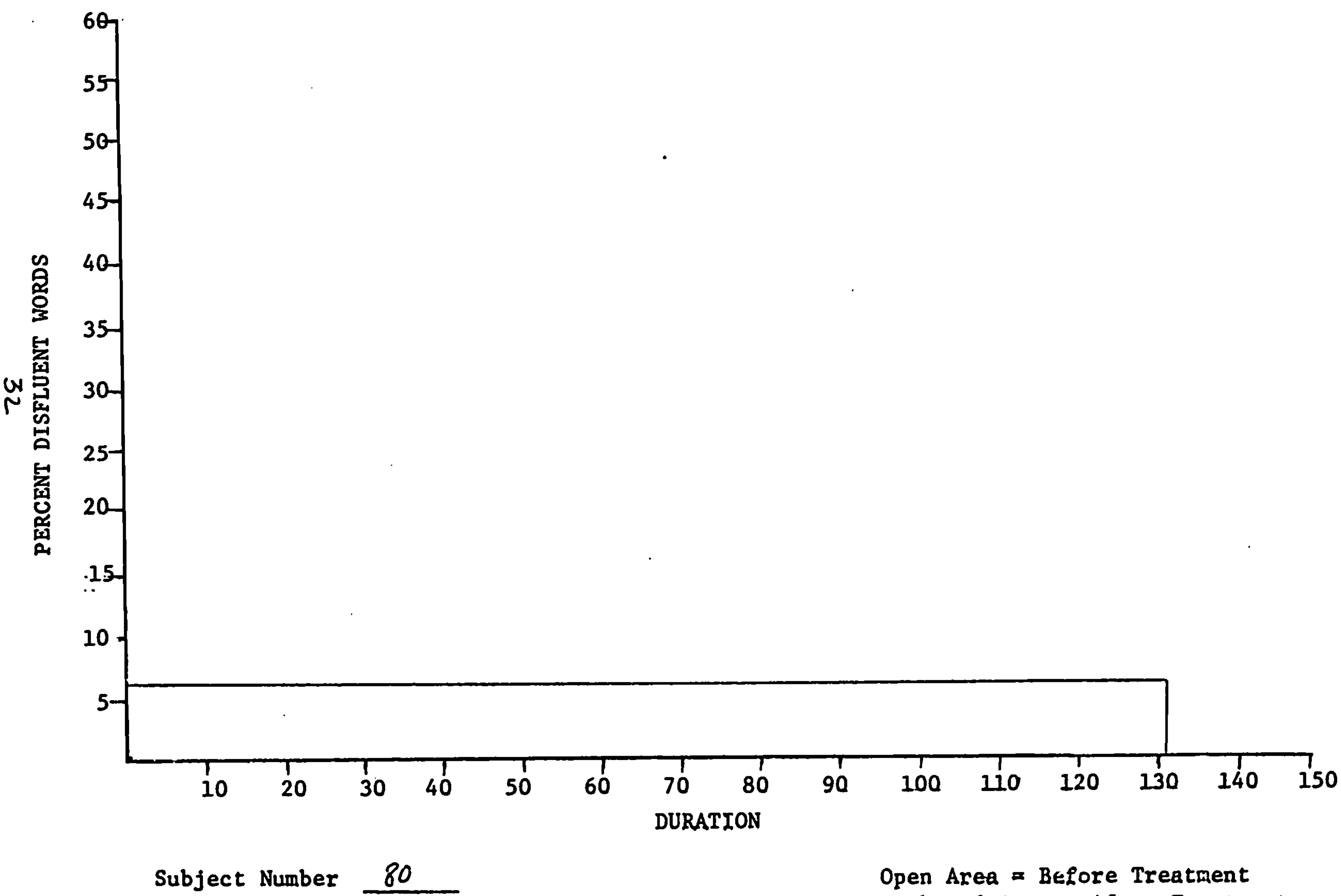
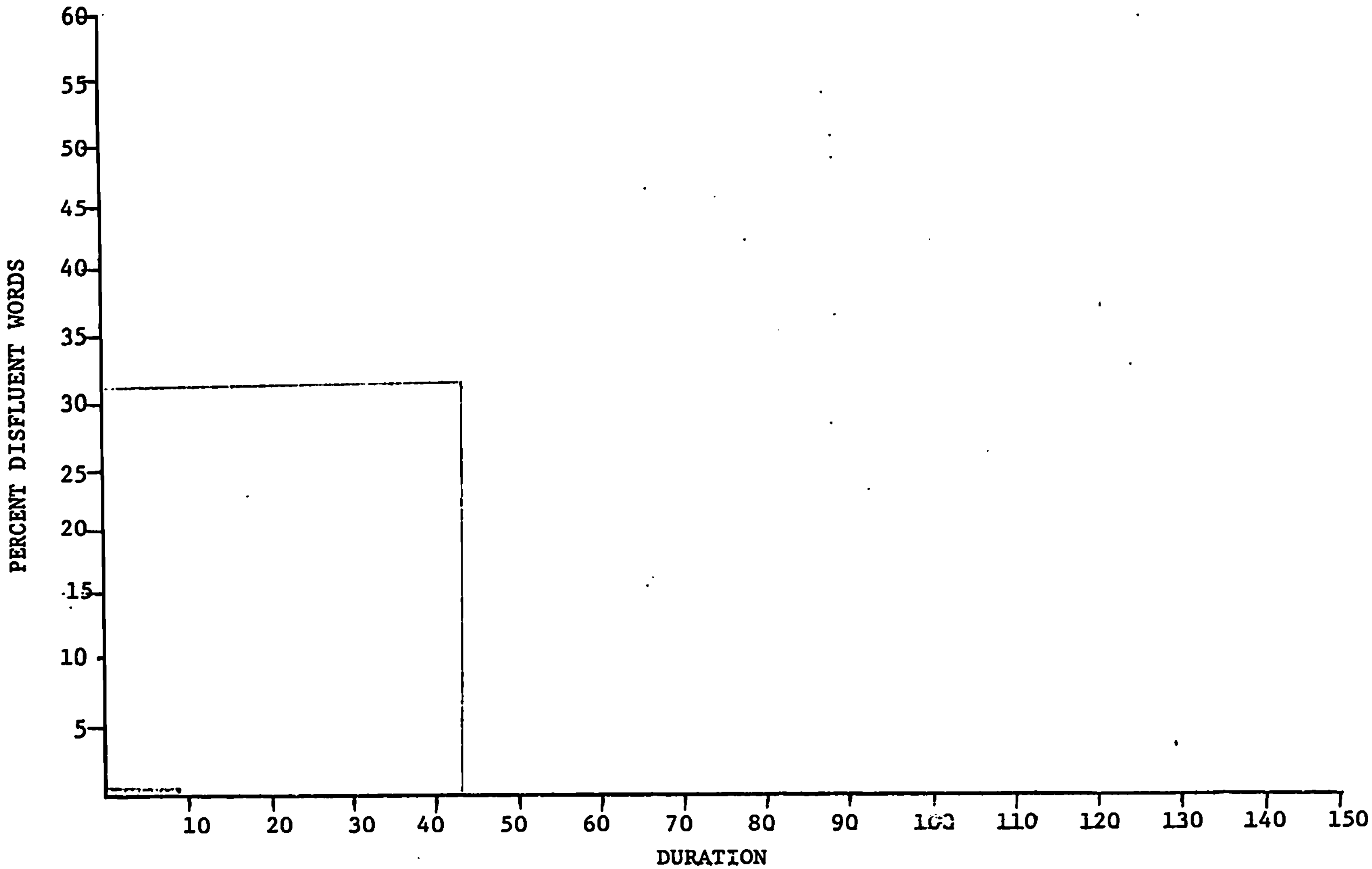


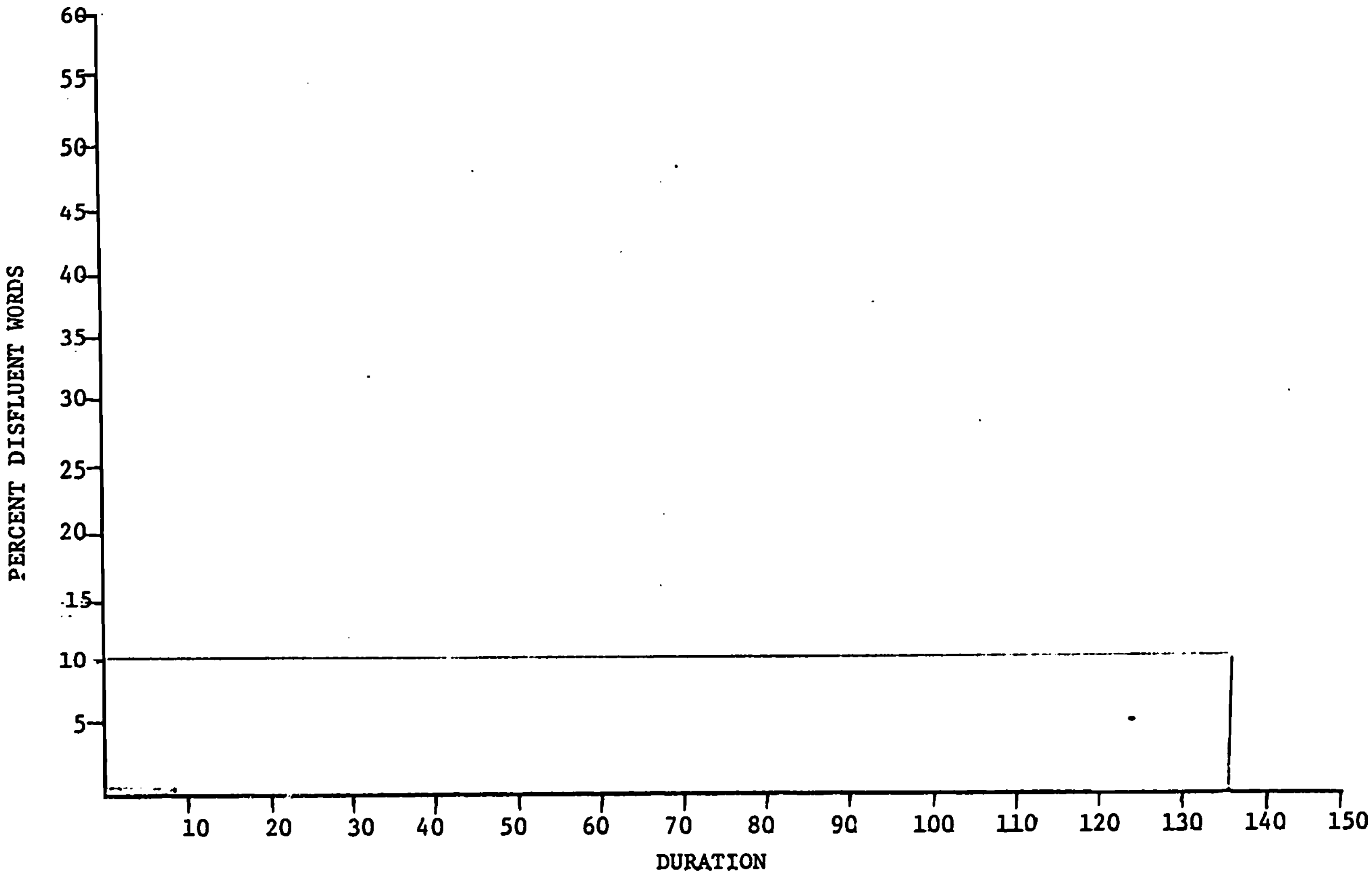
Figure 10. Area Function for Subject #80.



Subject Number 77

Open Area = Before Treatment
Darkened Area = After Treatment

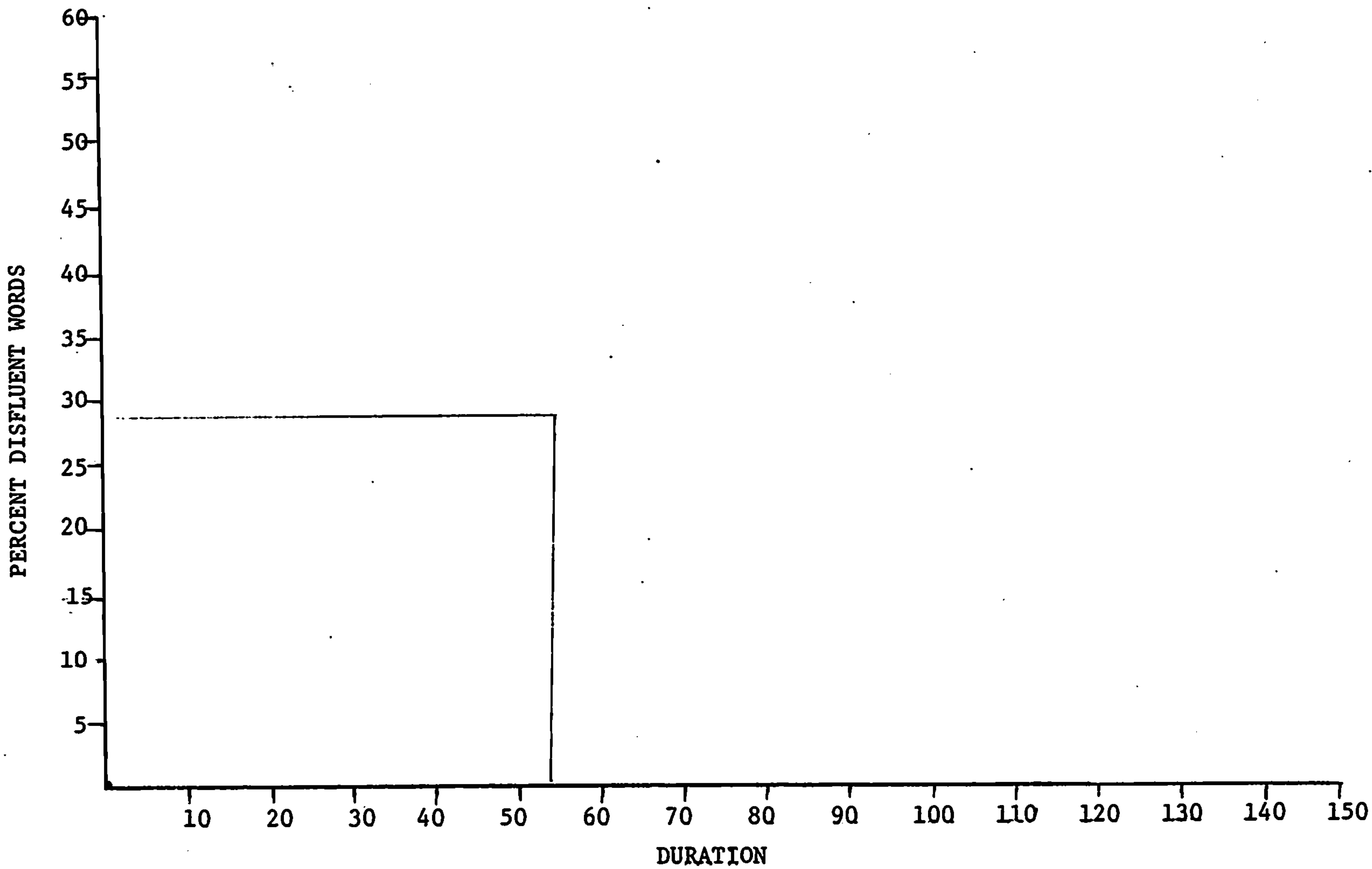
Figure 11. Area Function for Subject #77.



Subject Number 82B

Open Area = Before Treatment
Darkened Area = After Treatment

Figure 12. Area Function for Subject #82B.



Subject Number 88

Open Area = Before Treatment
Darkened Area = After Treatment

Figure 13. Area Function for Subject #88.

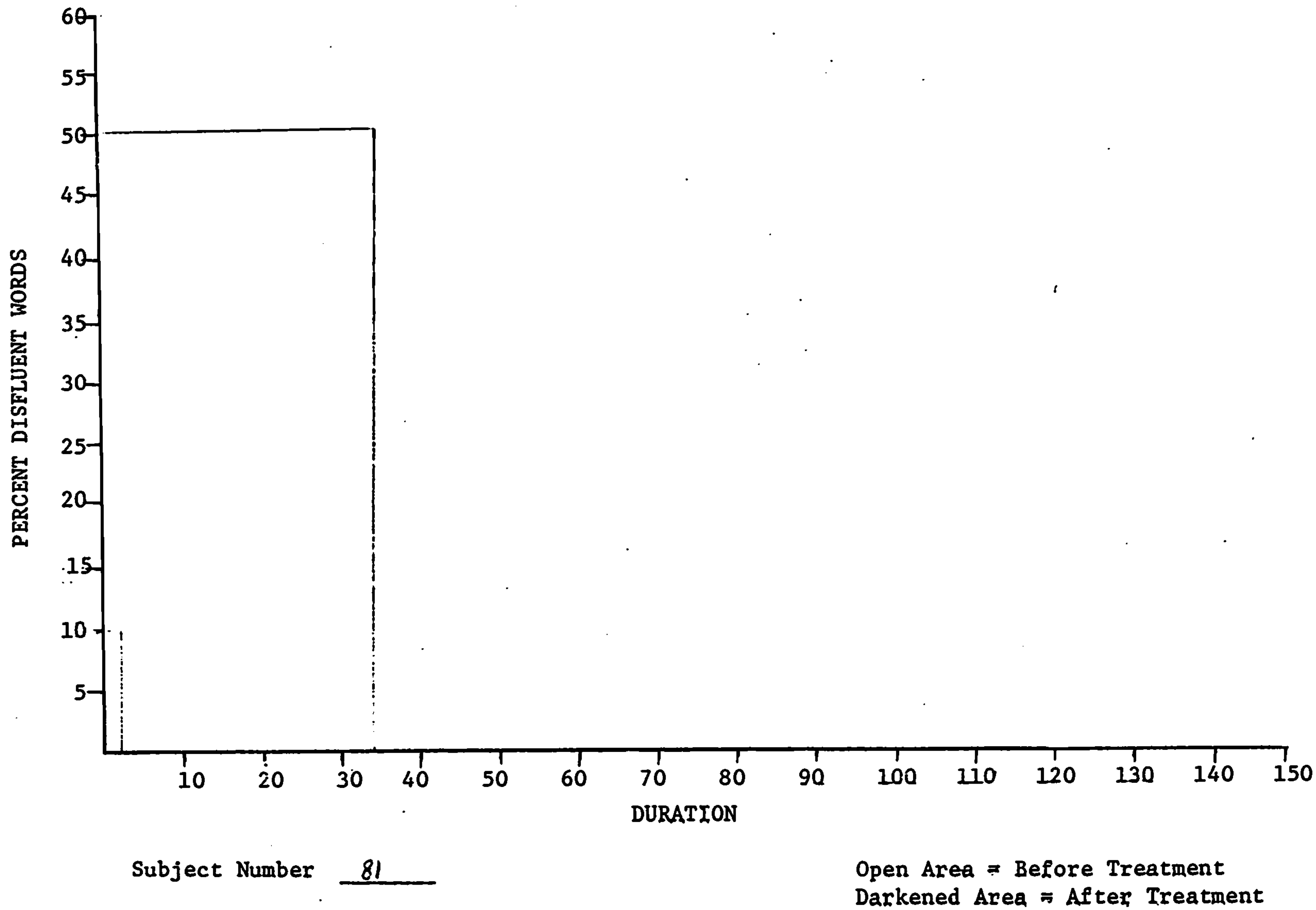
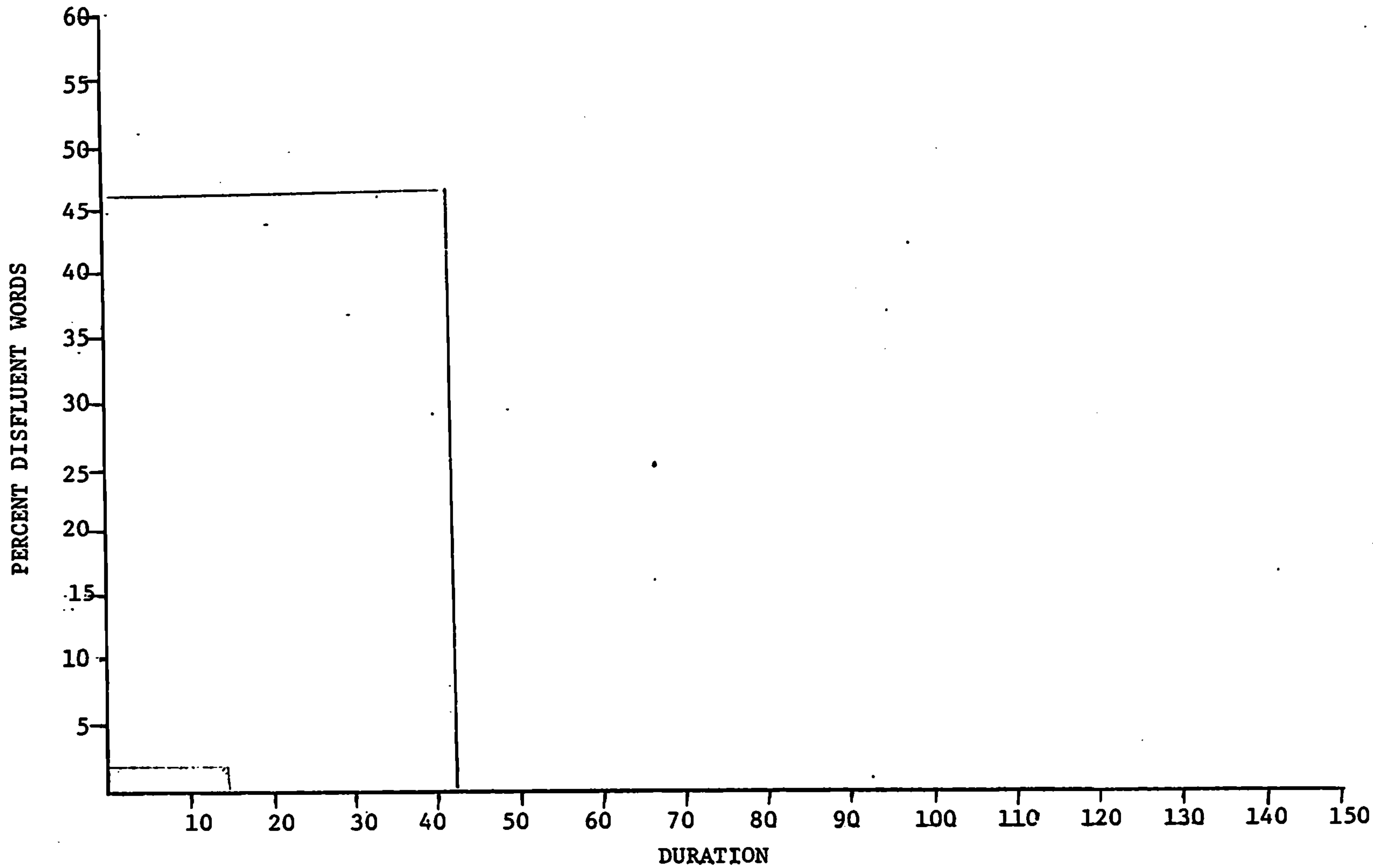


Figure 14. Area Function for Subject #81.



Subject Number 110

Open Area = Before Treatment
Darkened Area = After Treatment

Figure 15. Area Function for Subject #110.

speech block which occurred in the segment was then timed. The total duration of the nine samples was then determined. This procedure was applied to the randomly selected sample of twenty stutterer's before and after they completed the fluency shaping program.

In order to determine the relationship between subjective estimates of stuttering severity and the area plot a trained speech pathologist who was familiar with each of the cases was given a stack of cards which had listed on them the names of the subjects. The therapist was asked to rank order the cards in terms of his estimate of the severity of the subject's stuttering problem prior to the subject's introduction into the fluency shaping program.

A Spearman rank-order correlation (rho) was computed between the rank ordering of the area plots and the rank orderings arrived at by the speech pathologist (Table 5). The rank order correlation coefficient was equal to .93. This value was significant beyond the .05 level.

Follow-up Data on Fluency Retention

In order to establish an objective index of how well speech fluency was retained following release from the fluency shaping program, a randomly selected sample of 18 male and 2 female stutterers was examined. The median age of the subjects was 25 years, with a range from 8 to 52 years. The median time between program completion and the acquisition of follow-up data was 25 months.

Data showing pre-treatment versus follow-up levels of fluency, subjects' reports on post-treatment speech quality compared with pre-treatment speech quality and subjects' satisfaction with their speech are shown in Table 6. The disfluent word frequencies prior to treatment and again approximately two years following the program are shown in Figure 16. Examination of the figure will show that the follow-up measure shifted toward the low end of the abscissa. It is important to note that in the post-treatment oral reading task, 13 out of 20 subjects had disfluent word frequencies at or below one percent. In the post-treatment measures obtained in conversation, 9 out of 20 subjects scored at or below the one percent disfluency level. All cases showed decreases in disfluent word frequencies from pre-treatment to the follow-up measures. Both of these pre-treatment versus post-treatment differences (pre-reading versus post-conversation) were significant beyond the .005 level when tested with the Wilcoxin Signed-Ranks Test.

The subjects also furnished some self-report data. Of the 20 subjects, 19 indicated that their post-treatment speech quality was improved when compared with pre-treatment levels. One subject reported his speech was essentially the same as it had been prior to entering the program, and none of the subjects indicated that their speech was worse.

Table 6

Pre- and Post-Treatment Data

							FOLLOW-UP DATA					
					Percent disfluent words after treatment		Subject's report of post-treatment speech quality versus pre-treatment speech quality			Subject satisfied with current level of speech fluency?		
Subject #	Age	Sex	Treatment follow-up interval in months	Percent disfluent words prior to treatment (Reading only)	Reading	Conversation	Better	Same	Worse	Yes	Somewhat	No
22X	20	M	30	19	<1	3	X	X		X		
45	40	M	27	6	1	3	X			X		
28	52	F	33	15	2	1	X				X	
51	8	M	24	4	3	1	X			X		
37	36	M	29	8	1	1	X					X
25	33	M	33	3	<1	<1	X			X		
23X	16	M	30	33	9	4	X					X
40	23	M	28	6	<1	0	X			X		
46	21	F	26	1	<1	<1	X			X		
39	27	M	27	16	<1	<1	X			X		
85	45	M	6	6	<1	0	X			X		
79	28	M	8	20	1	1	X			X		
70	14	M	12	12	7	8		X				X
42	27	M	26	11	3	4	X					X
84	33	M	4	20	3	5	X			X		
82B	22	M	4	11	<1	2	X			X		
63	34	M	15	47	0	1	X			X		
56	17	F	21	27	5	10	X					X
72	12	M	11	17	4	5	X					X
74	22	M	10	19	<1	3	X				X	

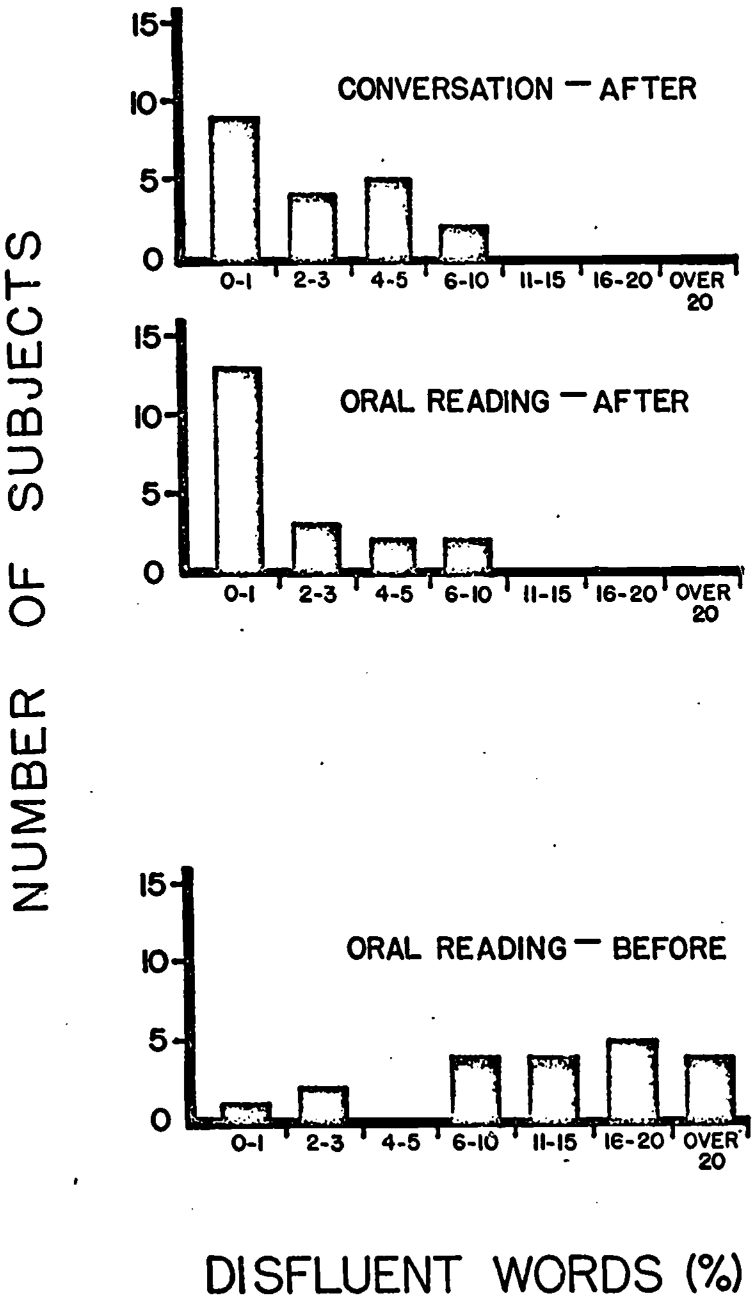


Figure 16. Pre- and post-treatment distributions of disfluent words.

39A

These self-reports were consistent with the observed changes in the disfluent word rates. A dozen of the subjects reported that they were satisfied with their new, current levels of speech fluency. Two indicated they were somewhat satisfied, but felt they could do better, and six said they were not satisfied with their current levels of speech fluency, because they were clearly aware that they had done better and could do better. One case, Subject #37, indicated that he was not satisfied with his current level of speech fluency, even though he scored at an essentially normal level of fluency. Further discussion with this subject revealed that he expected himself to have perfectly fluent speech at all times. At best, this is an unrealistic expectation, because most fluent speakers have a good many disfluencies in their speech.

Perceptions of Stuttering Inventory.

Self-report data have been collected on another sample of 19 stutterers who completed Program V. Only one sutterer occurs in both samples reported upon in this chapter. The self-report form used was an instrument designated as the Perceptions of Stuttering Inventory (Woolf, 1967). The instrument consists of 60 items. The person taking the inventory checks whether or not each item is characteristic of him at that point in time. There are three scales, each of which is based on 20 items.

The first scale deals with struggle (repeating a sound or word with effort, prolonging a sound or word while trying to push it out, etc.). The second scale is concerned with avoidance (avoiding talking with others of his own age group, avoiding talking to one or both of his parents, etc). The third scale deals with expectancy (wondering whether you will stutter or how you will speak if you do stutter, postponing speaking for a short time until certain you can be fluent, saying words slowly or rapidly preceding the word on which stuttering is expected).

Although the instrument is essentially a research instrument and much remains to be learned about its reliability and validity, a previous form of the instrument (Rothenberg, 1963) showed reliability coefficients in the middle to high .80's. Figure 2 shows the mean before-after scores on the Perceptions of Stuttering Inventory. The mean time between testing was approximately four months. The mean before-treatment scores were all in the moderately severe area of the scale. In the follow-up data, the mean scores are at the mild end of the scale. It is not unusual to find that the expectancy score is somewhat higher than the struggle and avoidance scores. Since several items on the inventory pertain to various aspects of attention to speaking prior to producing sounds (saying words slowly or rapidly preceding the word on which stuttering is expected; concentrating on how you were going to speak, e.g., thinking about where to put your tongue or how to breathe), we do not take this score to mean that there is expectancy

Table 7. Pre- and Post-Treatment Scores on the Perceptions of Stuttering Inventory (N=37)

Subject Number	Number of Weeks Between Scores	Struggle Before	Struggle After	Avoidance Before	Avoidance After	Expectancy Before	Expectancy After
67	28	15	0	16	0	17	8
76	52	13	14	13	13	11	10
77	48	12	2	3	0	10	7
78	44	16	2	7	3	10	2
79	36	8	1	9	2	11	2
80	32	14	0	16	5	6	8
82A	40	19	17	17	6	15	12
82B	20	9	0	15	1	11	7
83	16	12	8	13	9	9	8
84	16	9	1	7	3	8	6
85	40	12	0	5	4	11	1
88	3	19	6	16	10	15	6
92	8	15	11	11	0	11	4
93	4	11	0	12	0	10	1
94	3	2	2	0	1	7	5
95	28	10	3	14	2	6	3
96	4	9	2	16	4	8	3
97	4	13	0	11	0	10	0
98	4	10	2	16	2	15	7
99	25	8	5	9	1	8	5
103	20	15	1	14	1	15	3
104	2	14	1	5	0	8	5
105A	16	20	1	20	0	19	1
106	3	7	0	12	3	13	10
109	3	14	1	13	2	9	1
110	4	14	2	19	4	11	5
111	20	5	1	16	3	8	8
113	4	6	0	1	0	4	0
114	8	13	0	14	0	15	20
116	12	17	2	17	1	17	4
117	12	9	2	19	1	11	3
118	8	10	0	13	0	17	0
119	5	6	1	5	1	7	3
121	3	11	2	14	0	10	4
122	2	15	0	9	0	13	7
123	3	14	0	8	2	9	7
125	2	16	0	20	0	12	2
Means	15.7	11.9	2.4	12.0	2.3	11.0	5.0

of the actual act of stuttering. The slightly higher expectancy scores are generally indicative of the fact that the subjects are attending to the task of speaking fluently. It is worth noting that most of the subjects on whom the inventory scores were collected went through the program using the early initiation of transfer. We have observed that there is greater stability of fluency when the early transfer procedure is systematically employed.

General Observations.

There are other changes which we have observed in our subjects. First, there is usually a decided increase in the amount of verbal output as the subjects progress through the program. Apparently, as it becomes easier to speak fluently, the amount of verbal behavior increases. Secondly, we have also observed that many of the stutterers seem to become more socially agressive. That is, they display an increased willingness to go into situations that were previously uncomfortable. Third, we have observed some rather dramatic behavioral changes in our subjects in their everyday life situations. For example, one subject, a major in the military service who was a moderate stutterer, (approximate 10% disfluent word rate) felt that he would not be promoted because of his stuttered speech. After completing the fluency-shaping program, he was placed on the promotion list, attended Staff and General Command School and during oral presentations in classes there, was never given less than the top rating. He reported that it was unlikely that anyone at Staff and General Command School knew he was a stutterer. At the present time, this subject holds a command position at a large military base in Europe. He spends extensive portions of each day in pressureful communication situations and spends much time on the telephone. Personal obversations of his fluency made by our staff in his current situation have shown that he speaks with excellent speech fluency (now about 30 months after completing the program). His estimated disfluent word rate in conversation, including telephone conversation, was less than one percent. Other subjects have initiated college programs that they had not previously attempted because of their speech deficiencies, and have undertaken new types of jobs which could not have previously been handled, for example, becoming newspaper reporters, teachers, and businessmen. Also, three physicians have completed the program and in each case, they have reported that their professional responsibilities became much easier to handle. Another of the characteristics we have observed is that unmarried stutterers who improve the quality of their speech usually show dramatic increases in the frequency and intensity of their contacts with members of the opposite sex.

DISCUSSION

The development of a generalized fluency shaping program which was applicable to a wide range of subjects had certain other advantages. In particular, in comparison with other forms of therapy (Van Riper, 1958; Sheehan, 1970; and Starkweather, 1971) the amount of time the subjects spent in the program was relatively modest. The average total time spent by subjects in laboratory sessions supervised directly by the therapist was 29.8 hours. Additional time in transfer sessions required approximately an average of 20 hours. Thus, the total average time the subjects spent on the program was approximately 50 hours. The large majority of the subjects completed the program in between 40 to 60 hours. This is in marked contrast to therapies where the treatment may last for some years.

It is important to note that the Fluency Shaping Program was normally administered over a three week period. Apparently, one of the important variables, the intensiveness of treatment, produces rather dramatic and sudden increases in speech fluency, which in turn, are highly reinforcing to the subjects. It may be suggested from our experience with the new therapy that much of our traditional therapeutic practice may be incorrect in that it spreads small amounts of treatment over long periods of time, thus diluting and weakening any effects which the treatments may actually have.

The tight focus on specific forms of speech behavior seen in our Fluency Shaping Program is quite important for the specificity of training seems to be the key to the success of the program. While in overview, it may appear as if a great deal of time was spent in relatively short speech segments (i.e., sounds, one syllable words, two syllable words, and three syllable words), it is clear to the principal investigator that the rather specific articulatory skills which were learned in these exercises had a great deal of transfer value into the subjects' everyday life. Finally, the specificity of the training has another advantage in that it will eventually be possible to develop performance norms for the different program components. Such norms would permit the continual checking of an individual's progress against those of known reference groups, and would provide a basis for making adjustments within the program to give extra attention to deficiencies in learning evidenced by the subjects.

In an effort to deal with the observable aspects of stuttering it seemed parsimonious to take one of the more salient features of the problem and use it as our primary index of stuttering severity. The response measure chosen consisted of the number of disfluent words. The number of words in which at least one disfluency occurred was counted. The rationale for this measure was that there is essentially a fluency-disfluency continuum, along which each speaker can be placed at a given point in time. In addition, the measure covaries quite well with the clinical assessment of stuttering severity. The measure is an objective measure, reliabilities of scoring are high and it is possible to process large quantities of data in order to compute the disfluent word values for each subject. Of particular importance is the fact that this response measure displayed a great deal of lawfulness in the research reported here. The disfluent word frequencies before treatment (Table 4) were based on three standard 1000 word passages. The rates of stuttering ranged from .2% to 52% prior to treatment, with the mean being approximately 16%. Thus, the majority of subjects were from moderately severe to severe stutterers. With the introduction of the Fluency Shaping Program, the actual stuttering frequencies fell close to a 0 level during the actual administration of the program. In a standard 500 word reading passage after the completion of the Fluency Shaping Program the rates of disfluency averaged below 1%. In all cases, there were decreases in stuttering frequency from the pre-treatment to the post-treatment measures. This is one of the noteworthy aspects of the Fluency Shaping Program; the point should be noted that, unlike other treatment procedures, all subjects were able to learn the skills necessary for the improvement of fluency. Such a finding suggests the need to do further intensive research on this phenomenon.

While the disfluent word response measure was important and useful, it seemed to omit some useful information about stuttering. However, with a little more effort it was possible to derive a stuttering index which seemed to be potentially quite useful in both research and clinical setting. Our preliminary work on an index of stuttering severity used two response parameters, the frequency with which stuttered words occurred, and the duration of the efforts to initiate speech. These measures were objectively determined, and permitted us to avoid the use of rating scales. By counting the number of disfluent words in a standard 1000 word passage, and by establishing a standard sampling procedure by which nine stuttering instances were randomly selected and their durations established, the values of the variables necessary to derive the index were established. Disfluent word frequencies were multiplied by total stuttering durations to give an area function (Figure 1-15). The high correlation between the rank orderings by the speech clinician and the area functions is quite striking. The representation of the relationships between the stutterers prior to and then following treatment by the area functions closely paralleled the subjective feeling that the principal investigator and his staff had about subjects' performance prior to and following treatment. It would appear as if this type index of stuttering severity may be applied to speech samples derived from a variety of situations, thus producing a composite which could truly reflect the performance of the subject at different points in time without relying on the usual subjective estimates made by the subjects and their therapists.

Table 6 shows the disfluent word frequencies and self-reports on speech quality that were obtained in a follow up study of subjects who completed the Fluency Shaping Program. The distributions for disfluent word frequencies prior to and then again approximately two years following the program are shown in Figure 16. The post-treatment measures all shifted toward the low end of the disfluency-fluency continuum. In the post-treatment oral reading test, 13 out of the 20 subjects showed disfluent word frequencies at or below 1%.

In the post-treatment conversation measure 9 out of the 20 subjects scored at or below 1% disfluencies. In all cases, decreases in disfluent word frequencies occurred from the pre-treatment to the post-treatment follow up measures. The pre- and post-treatment differences for both conversation and reading compared with the pre-treatment baseline measures were significantly different at or beyond the .005 level when tested with the Wilcoxin Signed-Rank Test. It seems clear that the most subjects retained improved speech fluency without continued maintenance efforts by the therapists.

Limited self-reports were obtained from the sample used in the follow up study. Of the 20 subjects, 19 indicated their post-treatment speech quality was improved when compared with pre-treatment levels. One subject reported that his speech was the same as it had been prior to entering the program, and none of the subjects indicated their speech was worse. The self-reports are consistent with the observed changes in the disfluent word rates shown in Table 6. A dozen of the subjects reported they were satisfied with their current levels of speech fluency. Two said they were somewhat satisfied, but felt they could do better, and a half dozen said they were not satisfied with their current levels of speech fluency, because they were clearly aware of the fact that they had done and could do better. One case, Subject #37, indicated he was not satisfied with his current level of speech fluency, even though he scored at an essentially normal level of fluency in the follow up period. Upon further discussion with this subject, he indicated that he felt he should have completely fluent speech.

One of the items of information gained in conducting follow up studies was that many significant problems remain to be overcome in order to produce genuinely adequate follow up data. First, it is not desirable for lab personnel to contact the subjects. The reason for this statement is that the lab personnel were found to be cues for the production of fluent speech in the subjects. Consequently, direct contacts between subjects and lab personnel in follow up studies may distort the data because the subjects are making a special effort to perform properly in the presence of the laboratory personnel. Whenever possible, we tried to supplement our tape recorded feedback from subjects with third person reports. For example, one of our subjects was employed as a waiter in a restaurant, and colleagues who went to the restaurant had an opportunity to observe his speech fluency and report back to us. In another case, the Dean of the University of West Virginia Law School reported to a friend of the principal investigator that their top student had gone through our program and was now not only one of the best students, but was one of their more articulate students. In another case, the commanding officer of one of the subjects provided third person reports indicating that the subject was retaining good to excellent levels of speech fluency.

It is also not sufficient to ask for self-reports from the subjects about the adequacy of their speech fluency. One of the consistent observations we have made is that there is usually a shift in the reference level used by the subjects. That is, after completing the fluency shaping program, the subjects were usually less tolerant of disfluencies which occurred in their speech, and their judgment of trouble was often inflated because of this apparent shift in their frame of reference. It is quite apparent that extensive work must be done on the development of sampling techniques for acquiring representative speech samples from the subjects both prior to entering therapy and again upon completion of therapy. This is important enough to be researched in its own right.

As a means of supplementing our information regarding the changes produced in the subjects by the fluency shaping program, attempts were made to derive systematic self-report data with the use of a standard reporting instrument, the Perceptions of Stuttering Inventory (Woolf, 1967). This inventory provided an index of struggle, avoidance, and expectancy in stuttering. The instrument was used a number of times with the subjects. The data presented in Table 7 were collected from 37 subjects who responded to follow up study. The mean time between pre-treatment and post-treatment administration of the PSI was approximately 4 months. The rather dramatic changes in stutterers' perceptions of their behavior can be seen quite clearly with this instrument. The pre- and post-treatment differences were significant beyond the .005 level with the Wilcoxin Signed-Ranks Test. It seems clear that not only does the fluency shaping program produce changes in the observed quality of each fluency, but produces rather dramatic changes in the stutterer's perceptions of his problem. It might also be stated if one wishes to change the stutterer's perception of his problem, then the most effective way to do this is not by trying to change these perceptions through the use of counseling or psychotherapeutic techniques, but instead to approach the problem directly and change the characteristics of speech which generate the perceptual qualities.

The results indicate that, in general, stutterers can and do retain high levels of fluency after a single, three week period of intensive training. It is significant that in many instances the stuttering behavior had existed for 20 or more years prior to the training. It may be concluded that the fluency shaping program is sharpening the focus on how we should approach the problem of stuttering. In those cases where there has been some difficulty in retaining fluent speech, the main problem has been that the stutterers failed to acquire (or maintain) the correct basic skills in sound production. It appears that as long as the stutterer obeys certain "rules of speech mechanics" he will produce speech sounds that are fluent. However, when the movement and forces of speech gestures exceed certain values, at that point the stutterer manifests disfluent speech. Our experiences to date indicate that it is quite probable that there are few reasons why an individual who stutters must continue to experience the existing level of his speech handicap. We have worked with mental retardates, cases with cerebral palsy, and instances of stuttering that were so severe that it was virtually impossible to obtain the disfluent word rates on the baseline measures. An exciting and highly significant finding is that in every instance, it has been possible to establish fluent speech in the laboratory, and at worst, to demonstrate some lasting improvements in fluency in the everyday speech of most subjects.

CONCLUSIONS

The experience derived from the administration of the Fluency Shaping Program has shown that an intensive, systematic three week treatment program can produce markedly improved speech fluency in even severe stutterers. The program essentially served to reconstruct the articulatory habits of stutterers. By carefully teaching the stutterer how to produce the basic sounds and syllables of American English, and then by transferring these skills into the utterance of words and phrases, it was possible to teach all stutterers to speak fluently in the laboratory environment. Follow up studies conducted on an average of two years after completion of the Fluency Shaping Program showed that approximately 7 out of every 10 stutterers retained good to excellent speech fluency and reported satisfaction with their existing levels of speech fluency. Although the main response measure employed in the research was a count of the number of disfluent words uttered by the subjects under a variety of different standard conditions, an attempt was made to derive a more comprehensive objectively based index of stuttering severity. It was found that the parameters of stuttering frequency and the duration of speech initiation showed promise for yielding an objectively derived index of stuttering severity. The ratings of stuttering severity made by an experienced speech clinician were highly correlated with the index of stuttering severity derived from the frequency and duration measures. It appeared as if when combined with an adequate sampling of speech from the daily life of the stutterer, the new index should yield a rather comprehensive definition of stuttering severity which should be useful in a wide range of therapeutic and research settings.

In addition to using the objective indices to assess the impact of the Fluency Shaping Program, an effort was made to evaluate the stutterers' feelings about their own speech. A self report device, the Perceptions of Stuttering Inventory, was used. Post-treatment measures with the Perceptions of Stuttering Inventory conducted an average of four months following the Fluency Shaping Program completion showed that the stutterers' self ratings of struggle, avoidance, and expectancy were significantly lower than the pre-treatment measures. Other observations indicated that the stutterers, following completion of the Fluency Shaping Program, generally became more talkative, more sociable, and less likely to avoid important speaking situations.

A rather important overall result of a project was the demonstrated low cost of administering the Fluency Shaping Program. The program was set up and conducted on a one-to-one subject-therapist relationship, yet 57 subjects received treatment at a total direct cost of approximately $49,000, or less than $1,000 per subject. By eliminating from this total the cost of data collection and other research activities, it is estimated that a clinical program could be developed which could be delivered at a cost of under $500 per subject. Other potential gains in efficiency, for example, using the computer system or developing procedures that permit one therapist to work with a number of subjects, could conceivably reduce the cost even further. It should be noted that a cost level of $500 would be roughly one half the current rate for an equivalent amount of clinical treatment in private practice. It appears as if the ratio between the magnitude of improvement in speech fluency and dollars spent is greater in this program than in any of our traditional forms of therapy.

A development of some significant future potential involved the use of computer equipment as an adjunct to the Fluency Shaping Program. The function of the computer was to monitor the physical properties of speech sounds made by the stutterers. When the speech sounds met certain predetermined criteria, the computer indicated to the stutterer whether or not his responses were correct. The computer appeared to be a more reliable judge of speech sound characteristics than the human therapist. And, it also appeared as if the stutterer learned more quickly the specific movement patterns involved in producing speech sounds. Future development of the computer as an adjunct to the therapy program should involve the presentation of the actual Fluency Shaping Program's sequences by computer, the continuous monitoring of subject's progress through the program, and the possibility of proving the computer's capabilities to the point where it will be able to make judgments about speech sound characteristics contained in words and sentences. In addition, it may be possible to develop a computer diagnostic procedure for specifying speech sound deficiencies in stutterers. Finally, it is conceivable that the computer system can eventually be developed to the point where stutterers can communicate with the system by a telephone.

SUMMARY

A growing body of data has shown that with the use of systematic retraining methods it is possible to establish markedly improved speech fluency in stutterers. The research reported here had as its purpose the specification of behavior changes induced by the participation of stutterers in a fluency shaping program. A total of 57 stutterers, ages 8 to 59 years, participated in the research. Disfluent word frequencies were established in baseline oral reading sessions prior to the initiation of the program. A majority of the stutterers also took the Perception of Stuttering Inventory, a self-report device which measured the degree of struggle, avoidance, and expectancy in the stutterer's speech. Each stutterer worked intensively, 5 days per week for 3 successive weeks under the guidance of a therapist in reconstructing the specific articulatory skills involved in the production of American English and transferring the new articulatory skills into conversational speech. Large, significant pre- and post-treatment differences were observed in the subjects on measures of disfluent word frequencies. A newly derived objective index of stuttering severity was also shown to correlate significantly with global ratings of severity made by a speech pathologist. The new index showed very clearly the nature of the speech changes induced by the fluency shaping program. Post treatment measures on the Preceptions of Stuttering Inventory made on the average of 4 months after the stutterers completed the program, were significantly lower than the pre-treatment measures. Followup data on subjects' speech fluency and self-reports on satisfaction with their speech collected on the average two years after completion of the program showed that large and significant gains in speech fluency had been retained for 7 out of 10 subjects. Additional developmental work was conducted which involved the use of an on-line computer system to monitor the speech sound characteristics of the subjects in the fluency shaping program. The computer system fed back information to the subject about the accuracy of the responses that were made. It was concluded that the fluency shaping program was an effective means of treating stuttering.

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Appendix A

Computer Assisted
Fluency Shaping

Preliminary developmental work was performed on the use of a computer to judge the accuracy of correct responses made by stutterers as they worked in the fluency shaping program. The computer provided an objective judgment of the gentleness of speech onset. By bootstrapping (i.e., setting the computer to accept and reject sounds according to judgmental criteria of an experienced human therapist, and then systematically applying these criteria) the reliability of the judgments made about certain sounds by the automatic system appeared to be better than that of even the best human therapist.

The equipment used for this portion of the research included a simple microphone which was hooked to a headband and suspended in front of the subject's mouth, an amplifier circuit which sent the magnified signal to the computer system and an on-line computer. The computer system consisted of a Digital Equipment Corporation PDP-81 and an AX08 analog-to-digital convertor. The signal acquisition routine of the computer was arranged to trigger on voice onset. The incoming signal was sampled once every millisecond. The computer was used to control the analog to digital conversion, to rectify the converted digital values, and to store these values in its core memory. The computer sampled the incoming speech signal for 500 milliseconds following voice onset. The stored amplitude versus time contour was then compared to a previously computed criterion value.

Application of the computer in its present form is very rough, and no attempts have been made yet to calibrate the system against external physical parameters measured in speech onset. The development of the system was conducted empirically. That is, the system was altered until the criterion values stored within the computer approximated the same judgmental criteria used by the human therapist. However, the specific decibel versus time values of the criterion values have not yet been computed because of a lack of appropriate equipment for the task. Much work remains to be done before a reliable and effective computer program can be devised.

At the present time it appears as if the four classes of sounds used by the experimental system have different reference values. However, as was indicated above these specific reference values have not been measured or programmed into the machine. The computer application, in its present form, is most accurate in judging the onset characteristics of vowel sounds and the Class II consonants (consonants which are represented by the letters R, L, M, N, etc.). The amplitude contours for the Class III and Class IV sounds are apparently different, and the present computer system does not judge them with the same degree of reliability with which it judges the simpler sounds.

The computer system was arranged initially so that when the stutterers completed a response correctly a message was typed out (such as great response, excellent sound, etc.). In its early version, the system was arranged to make a negative statement when the stutterer made an incorrect sound (that was an awful sound, bad, bad; etc.). Observations with the use of this version of the computer application suggested that perhaps the negative statements should be eliminated. And, finally, because the teletype output rate was only 10 characters per second, it was decided to eliminate all sentence-like feedback. Instead, the system was arranged so if the response made by the subject was correct then the computer signaled by typing O.K. on the teletype. If the response was incorrect the system made no response on the teletype. The stutterer then had to emit the previous response over again in order to continue through the exercises.

Although the unsystematic use of the computer system made it difficult to acquire specific comparative information, it appeared as if the subjects were able to learn somewhat faster when they were using the computer than when working with the human therapist. However, at no time was a subject run completely through the fluency shaping program with the computer as the primary judge of the accuracy of his responses. The computer was used sparingly because of the expense of running the computer system, because of the limited availability of the system, and because a trained individual was required to operate the system for purposes of our experimental work. It appeared, however, as if removal of the human element somewhat reduced disruptions in the subjects' concentration and permitted more attention to be paid to details of speech behavior involved in the program.

Further details of the computer system are described in the next appendix, which contains a copy of an article which appeared in the February, 1972 edition of the Hollins Bulletin, a campus publication.

Appendix B

When the Stutterer Meets
the Computer

Hollins Bulletin
February 1972

WHEN THE STUTTERER MEETS THE COMPUTER

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Stuttering and its treatment have been a subject of major concern for centuries. Of course, we all know what stuttering is: it is the amusing little "B-B-Bugs B-B-Bunny bounce;" it is the little boy next door who has the cute hesitations in his speech; or it is that funny man on the television screen who can't say his words at the right time.

Few of us really know, however, what it is like to try to switch on our speech mechanism and find that the system will not work. Imagine, if you will, the frustration of being a physician handicapped in the conduct of your day-to-day practice because of an inability to say more than three words without stuttering for two or three seconds on each word. Or consider yourself as a lonely 40-year-old woman who, in effect, turned off on the world at the age of 20--all because of a persistent stutter which you could not control. Or, if you can, think of yourself as a boy of 12, unable to speak freely with your friends and becoming more and more timid because you have to fight to get your words out. If you are able to imagine realistically any one of these situations, then you might begin to have some feeling for what it is like to be a severe stutterer. This handicap often leads to emotional conflicts and frequently severely limits the stutterer's relationships with other people.

Most forms of therapy developed in this century to cope with stuttering have focused on the possible role of emotional factors as a basis for the problem. The assumption has been that the fundamental cause of stuttering involves either the emotional structure of the individual's personality or a deep-seated emotional conflict. The observed stuttering behaviors were looked upon as symptoms of a deeper problem. This traditional view held that the best way to assist a stutterer in overcoming his problem was to resolve the underlying emotional conflict. The basis for maintaining that stuttering was an emotional problem came from "common sense" interpretations (a risky business at best) and <u>not</u> from carefully conducted research. Whenever the psychoanalytically derived forms of therapy did not work, the negative results were said to prove how hard it was to isolate and work through the emotional problem. The relative lack of success of analytically derived stuttering therapies led to attempts to find other forms of therapy.

My own laboratory in the Hollins Department of Psychology has been involved with research on the problem of stuttering for the last five-and-a-half years. Our approach discarded elaborate, over-conceptualized views of the problem and focused instead on relatively straightforward and measurable aspects of stuttering.

It soon became quite apparent that we had two major components to our research. The first was the basic scientific aspect which was concerned with gaining an understanding of this phenomenon we call stuttering. The other aspect of the research, and certainly the part of our work which is of interest to most people, was the technological aspect; that is, what had to be done in order to build an effective therapy for stutterers. In this report, I shall summarize briefly the basic research and will describe in more detail our work on developing treatment procedures.

Our basic research has led us to certain conclusions about stuttering. First, speech mechanisms are feedback-guided devices. That is, certain properties of muscle movements in speech production are detected by sensors (receptors in the ears and sensory elements in muscles) which feed information to the brain to be used in guiding further speech movements. Evidence for the preceding statement comes from the fact that, if we disturb the sound of a normally-fluent speaker's voice by using delayed auditory feedback--a special tape recorder which returns his speech sounds to his ears two-tenths of a second after he utters them, the effect is dramatic. There is a marked disruption in the cadence of his speech, a change in the quality of his voice, and a deterioration in his articulation accuracy. Some fluent speakers may actually stutter while receiving delayed auditory feedback.

Additional data from a number of laboratories have shown that various types of stimuli will improve fluency in stutterers. For example, a loud continuous noise presented to the stutterer through headphones usually results in improved speech fluency. When the noise is turned off, stuttering returns. When delayed auditory feedback is presented to stutterers, the effect is a marked enhancement in speech fluency. Again, when the machine is turned off, stuttering returns.

Data from many experiments have led us to conclude that the probable mechanism mediating stuttering is located in the middle ear. In the ear canal are two small muscles--the tensor tympani and the stapedius--attached to the three tiny bones of the middle ear. These muscles normally contract in fluent speakers just <u>before</u> a speech sound is initiated. The muscles also contract when a loud noise is presented to the ears. Middle ear muscle contractions cut down on the intensity of sounds that arrive at the inner ear. In stutterers, it appears that the middle ear muscles may contract at about the <u>same time</u> speech sounds are initiated. The effect of the delayed contractions is to cut out the first portions of the auditory feedback signal which are critical for speech guidance. The onset of speech is thus interrupted by disturbed auditory feedback.

Enough about the middle ear mechanism which may be responsible for stuttering; readers interested in further details can write to me for reprints of technical articles. Let us turn now to the treatment program which has been developed in our Hollins laboratory.

We had several goals for our work on developing a treatment program for stutterers: the procedures (1) had to work well, (2) could not employ expensive apparatus, and (3) had to be simple enough so that extensive training in how to use the program would not be necessary.

Our first fluency-shaping program was based on the pioneering research of Dr. Israel Goldiamond, who in 1965 published an article indicating that it was possible to establish fluent speech in stutterers under laboratory conditions. Our early work bore out Dr. Goldiamond's findings. However, one of the major difficulties with the early fluency-shaping program was that most stutterers could not easily transfer the new, fluent speech pattern from the laboratory into their everyday lives. Over the course of the last five years, we have developed five different versions of the fluency-shaping program. With each version, our subjects found it easier to retain fluency.

Gradually we learned that one of the fundamental problems in the early fluency-shaping programs was that we were asking the subjects to learn too much at one time. We established fluent speech by slowing the subjects' speech down to about 30 words per minute by drastically extending the duration of their speech sounds during an oral reading task. As the subjects became proficient at speaking with extreme sound prolongation (a technique which produces fluency in all stutterers we have observed), we gradually increased the rate at which they read. Later, they began to use slowed speech in conversations within the laboratory and, finally, they transferred this slow, normal speech to their daily lives. Lack of success in retaining fluency seemed to be related to the fact that the subjects were not absolutely certain of the specific movement patterns required to maintain fluency.

An important breakthrough came when we recognized that we were probably not teaching the fundamental skills required for fluency in a clear and concise manner. Instead of asking the subjects to produce long chains of speech in the form of sentences, we changed the program by having our subjects learn to speak short, single words fluently, then they moved on to more complicated speech forms. One of the important results of this simple modification was a great increase in the ease and reliability with which the stutterers could carry the new fluent pattern into their everyday life.

Encouraged by our initial success in improving the program, we began to analyze further the details of our training procedures. A series of observations showed that one of the necessary conditions for achieving good speech fluency was that the stutterer had to know exactly how to make a given sound. We learned that stutterers were deficient in the ways in which they produced many of the basic speech sounds. Specifically, we found that stutterers initiated speech sounds with too much amplitude, that individual speech sounds were made too briefly, and the transitions from one speech sound to another were made too rapidly.

In an effort to improve the training procedures, we again revised the program. We constructed a programmed text which took the subject step-by-step through the entire fluency-shaping sequence. The first steps in the program focused on how to produce basic sounds of speech. By working with each speech sound in isolation, it was possible to teach the stutterer precisely what should be done in order to produce that speech sound correctly. The skills required to produce the sound represented by the letter "P" are markedly different from the skills required to initiate a vowel sound. The puff of air which precedes vocal fold action in "P" requires a more complex movement sequence than do vowel sounds. We gradually refined the instructional sequence by retaining steps which worked and by eliminating those steps which did not. After about three years of work we finally derived an efficient program for systematically establishing improved speech fluency in stutterers.

In its present form, the fluency-shaping program takes a stutterer through the training exercises at his own pace, supervised by one of our therapists, in approximately 40 to 60 hours. We have worked with over 120 stutterers now, and have been pleased to find that approximately seven out of ten stutterers retain exceedingly high levels of fluency after two or more years following completion of the program. In those cases where there has been some difficulty in retaining fluent speech, the main problem was that the stutterers failed to acquire the correct basic skills in sound production prior to moving on to more complicated skills such as sound blends, word transitions, and sentences. In most cases corrective action has consisted of more training on how to produce the basic sounds of speech. In summary, at this point we feel rather comfortable with the fluency-shaping program and are preparing to release the materials for publication in the near future.

Our experience to date indicates that there is no real reason why an individual who stutters must continue to experience the existing level of his speech handicap. We foresee the potential development of training procedures for very young children which will serve to eliminate or markedly reduce the disfluent speech of youngsters and prevent stuttering from developing into the gross disability that it often becomes. Beyond that possibility, some of our recent work has suggested that a new form of stuttering therapy is possible. This new therapy is based on the use of a computer as the therapist (or more properly, as the therapist's assistant).

During the past two years, we learned a great deal about the specific movement patterns involved in producing the sounds and syllables in American English. It occurred to us that we could probably ease the task of the therapist, improve the accuracy with which judgments were made about the correctness of the subject's speech sounds, and increase the efficiency of the stutterer's performance in the program if we could "teach" a computer how to make judgments about speech sounds.

Some background is called for prior to describing the computer as therapist. During the fall of 1970, Hollins was awarded a grant from the National Science Foundation to assist in purchasing on-site computer facilities. A small but rather versatile and powerful computer system was installed. This computer, a PDP-81, referred to as a "mini" computer, was manufactured by the Digital Equipment Corporation of Maynard, Mass.

Versatility is a key descriptive term for our computer system. The computer can simultaneously work with six different users on routine computational problems. Or, what is even more important for many of our research purposes, the computer can be used in "on-line" applications. That is, the computer can be an active participant in an experiment. Characteristics of electrical signals can be rapidly measured by the computer, comparisons can be made between properties of the signals and stored reference values, and then decisions can be made by the computer based upon whether or not the incoming signal meets certain predetermined criteria. Less than one thousandth of a second may be required to run through the sequence just outlined. The rapid, on-line decision-making capability of the PDP-81 permitted us to establish computer-assisted fluency shaping.

In collaboration with Prof. Keith Hege, of the Department of Physics, and Reggie Schoonover, one of our graduate students, we began to attack the problem of how to use the computer as a therapist. The first task was to introduce the sounds made by the stutterer to the computer. The sound of the stutterer's voice was translated by a microphone into an electrical signal to be transmitted to the computer through a special circuit. Another device took the continuously changing electrical signals associated with the stutterer's voice and converted them into a series of pulses suitable for reading by the main processing section of the computer.

The next step involved developing a series of instructions for the computer's use. The instruction set had several purposes. First, in a fraction of a second, the computer read the properties of the incoming signal and placed this information in a memory unit. Next, the computer searched through its memory to find the appropriate reference values for the specific sound that the stutterer was speaking. Finally, again in just a tiny part of a second, the computer compared the incoming signal with the standard and made a decision. If the incoming speech signal met certain criteria, the computer signalled the subject that the speech sound had been made properly.

One of the exciting bits of information coming from the early use of the computer was the fact that the stutterers really liked working with the machine. They felt the computer was consistent and fair in its judgments about the adequacy of their speech responses. Previously we had been asking the therapists to make decisions about rather minute characteristics of behavior; it was no surprise to find that the computer was a more reliable judge than the human therapist. One of the meaningful results of using the computer as therapist was that stutterers learned more quickly the specific movement patterns involved in producing speech sounds. Our interpretation of this phenomenon was that removing the human reduced disruptions and allowed the subject to concentrate on learning the speech task.

At the present time, the computer is working solely as a judge of speech sound accuracy. The stutterer works through our programmed text while the computer listens to him, tells him whether or not he is correct, and signals when to go on to the next step in the program. However, the computer is potentially far more useful. Our next step will be to construct an instruction set for the computer that will contain the performance goals that must be met by the subject at each step of the program before he is permitted to go on to the succeeding steps. Although the computer is set up now only for the task of monitoring single-syllable and single-word utterances of stutterers, we foresee the possibility of improving its capabilities to the point where it will be able to make judgments about sounds contained within sentences.

To push on slightly into what might now sound like science fiction (but really isn't), we are beginning to explore the possibility of having the computer diagnose the speech-sound deficiencies of individual stutterers. For example, the computer will listen to the subject speak a standard series of words and phrases, measure properties of the basic sounds of speech, and print out a report that will show a profile of sounds which will require the greatest amount of attention during the retraining period. For example, we may find that, for some stutterers, the stop-consonants B, P, D, and T require more work than R, L, M, and N. The computer will probably eventually be writing individual prescriptions for treatment based on the results of a diagnostic test which it conducts.

We are not content to stop with this short look into the future. Beyond the prescriptive operations, we foresee the possibility of arranging for stutterers to work with the computer via telephone. The computer can be equipped with peripheral items which will allow it to communicate via telephone. The advent of Dial-a-Therapy will not be for some time yet, but we may be assured that it is technologically feasible. If we succeed in these steps, then it is conceivable that in a few years there will be a relatively inexpensive computer-assisted therapy for stuttering available in a large number of speech clinics around the country. We may also see the development of a regional computer center for the treatment of stuttering (and possibly other speech disorders) through the use of remote-access therapy.

One final point should be considered. Does the new therapy format dehumanize stuttering therapy? Dehumanization is a peculiar term, subject to many interpretations. It is often used to denote any situation in which a human confronts a machine and to imply that, in this situation, the quality of human life is thereby degraded. My judgment is that the computer as therapist does not dehumanize. To the contrary, it helps people achieve that remarkably distinguishing human characteristic--free, unrestrained speech.

Appendix C

Changes in Reliance on Auditory Feedback Cues as a Function of Oral Practice

Journal of Speech and Hearing Research
1971, _14_, 307-311.

CHANGES IN RELIANCE ON AUDITORY FEEDBACK CUES AS A FUNCTION OF ORAL PRACTICE

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This experiment used a two-by-two factorial design to investigate the effects of two levels of oral practice and two types of auditory feedback upon reading times and number of speech disfluencies for 60 normally fluent speakers. During tests under delayed auditory feedback, subjects who had experienced six previous oral reading trials on a standard passage under normal auditory feedback made significantly fewer articulation errors and had significantly shorter reading times than subjects without prior reading practice. Tests of practiced subjects vs nonpracticed subjects under normal auditory feedback showed no significant differences in articulation errors or reading times. It was suggested that functional properties of auditory feedback cues were temporarily changed by oral reading practice.

The adaptation effect in stuttering refers to the finding that stuttering frequency decreases with successive readings of the same material. During adaptation, stuttering frequency follows a negatively accelerated curve, generally reaches a low plateau from the eighth to twelfth reading, and is a relatively transitory effect (Wingate, 1966a). Concepts used in accounting for the adaptation effect in stuttering have included: reduction in fear or anxiety; increased familiarity with the material; decreased propositionality of the material; and the extinction of a learned response (Wingate, 1966b). However, none of these interpretations have been adequate for providing an understanding of adaptation phenomena (Beech and Fransella, 1968).

Our interest in the adaptation effect developed out of a program of research on the exploration of variables that have been shown to directly alter the frequency of disfluencies in stuttered speech (Webster and Lubker, 1968). The observed relationships between such readily manipulatable stimuli as masking noises (Cherry and Sayers, 1956; Sutton and Chase, 1961; Webster and Dorman, 1970), delayed auditory feedback (DAF) with both fluent speakers and stutterers (Lee, 1950; Fairbanks, 1955; Soderberg, 1968; Webster, Schumacher, and Lubker, 1970; Yates, 1963), and measured changes in speech fluency suggest that auditory feedback figures prominently in speech guidance in both stutterers and fluent speakers.

It is accurate to state that the role of auditory feedback in speech production is incompletely understood. Yates (1965) has hypothesized that the disruptive effects of DAF on fluent speakers are a function of the degree to which individuals depend on auditory feedback for the normal control of speech. Such a hypothesis implies that speakers rely differentially upon kinesthetic and sensory feedback from the speech organs, bone- and air-conducted auditory feedback, and central nervous system control processes. Goldman-Eisler (1968) reported that practice by normally fluent subjects on conversational speech tasks resulted in overall increases in speech rate. Her data showed that reductions in hesitation pauses were responsible for observed rate increases. To account for the results, Goldman-Eisler suggested that improvements in "verbal planning," the cognitive processes that precede speech, had occurred. The fact that certain measurable parameters of speech have been shown to change as a function of oral practice means that it is probable that other properties of the speech act may be modified through similar experiences.

This study tested the hypothesis that the reliance of normally fluent speakers on auditory feedback cues would be reduced by practice on an oral reading task. It had been previously suggested (Webster and Lubker, 1968) that such changes in the use of auditory feedback cues might provide a means of explaining the results seen in stutterers who demonstrate adaptation effects. However, the present hypothesis is more general in form and is directly testable. It addresses itself to the possiblity that if, as Yates (1965) has suggested, there is differential use of auditory feedback cues by different individuals, then it would be important to test the possibility that specific forms of experience may, at least temporarily, shift the relative roles of cues used in speech guidance.

METHOD

Subjects

The subjects were 60 female undergraduate students ranging in age from 18 - 21 years and recruited from introductory science courses at Hollins College. None of the subjects reported a history of hearing problems, and none displayed speech disorders.

Apparatus

A Lafayette-modified Bell & Howell tape recorder was used to provide both normal auditory feedback and DAF to headphones worn by the subjects. Sound levels at the headphones during speaking were adjusted for each subject to a SPL of approximately 70 dB. The delay interval used for DAF was 0.2 sec. and was calibrated on a Tektronix oscilloscope (Model 561).

Procedure

Subjects were randomly assigned to the cells of a two-by-two factorial experiment. The independent variables were normal auditory feedback (NAF) vs delayed auditory feedback (DAF), and oral practice (OP) vs no practice (NP).

The two groups of subjects who experienced OP read two standard paragraphs (320 words) aloud under NAF for six successive trials, with a 15-sec rest period between trials. On the seventh trial one group received DAF while the other group continued under NAF. The two NP groups read the standard paragraphs aloud one time. One group received NAF and the other group received DAF.

TABLE 1. Mean number of articulation errors and mean reading times for all treatment conditions.

	Normal Feedback		Delayed Feedback	
	Errors	Time	Errors	Time
No practice	2.0	101.6	19.7	131.5
Oral practice	2.3	101.0	6.1	118.4

The number of articulation errors and reading durations for the paragraphs were determined from tape recordings of the experimental sessions. An articulation error was recorded when subjects repeated portions of words, left out portions of words or whole words, or disproportionately increased durations of parts of words. Reliability measures on articulation errors were performed on 20 randomly selected trials by the second author. At least 48 hours separated the two counts. Count-recount agreement for the 20 samples averaged 94%. The agreement score was consistent with both intra- and interjudge reliabilities previously observed in our laboratory.

RESULTS

A two-way analysis of variance was performed using articulation errors as the dependent variable; another two-way analysis of variance was performed on reading durations. The independent variables were levels of practice and type of auditory feedback. For the articulation errors measure, feedback, practice, and the practice by feedback interaction were significant (the respective values being: $F=29.89$, $df=1/56$, $p<0.01$; $F=11.11$, $df=1/56$, $p<0.01$; $F=11.79$, $df=1/56$, $p<0.01$). Table 1 shows the mean number of articulation errors for all groups. The difference in mean number of articulation errors made by the OP and NP subjects under NAF was not significant. However, under DAF the OP subjects made significantly fewer articulation errors than the NP subjects ($t=3.40$, $df=28$, $p<0.01$). The same findings hold for the means of the reading duration scores (Table 1). The analysis of variance showed that feedback, practice, and the practice-by-feedback interaction were significant (the respective values being: $F=61.90$, $df-1/56$, $p<0.05$). The difference between the means of the OP and the NP subjects under NAF was not significant. The mean reading duration under DAF for OP subjects was significantly lower than this same measure for NP subjects ($t=2.60$, $df=28$, $p<0.05$).

DISCUSSION

The lack of significant differences between the practiced and nonpracticed subjects under normal auditory feedback suggests that the effects of practice must be inferred to alter processes which are not directly observable. Thus, when it is observed that practiced subjects performed better than nonpracticed subjects under DAF, any interpretations that are advanced must consider the role that various internalized processes may serve in speech guidance.

Hypotheses concerning probable internal processes could range from relatively simple ideas about the possible role of auditory feedback to complex concepts involving changes in the meaning of verbal stimuli resulting from practice or to even more complex ideas that deal with fundamental brain processes. It is both parsimonious and fruitful of further research to consider first those hypotheses that are directly testable. For example, one deduction which requires little inference regarding unknown central nervous system processes would hold that practiced subjects, when tested under delayed auditory feedback, relied relatively less on auditory feedback than nonpracticed subjects. The specificity of action by DAF on auditory cues makes this hypothesis particularly attractive. It would appear as if temporary changes in the role of auditory feedback may have been induced as a direct result of oral practice on a given task. And this interpretation is consistent with Yates's

(1965) suggestion that the degree of disruption produced by DAF in the speech of normally fluent subjects is a function of the degree to which auditory feedback is used in speech guidance.

Cne deficiency in the hypothesis that the role of auditory feedback was changed through practice is that it is not clear whether any form of oral activity--continuous reading of different material, for example--produces the same reduction in apparent reliance on auditory feedback as does practice on one specific task. Given the present results and their interpretation, it would be predicted that a necessary condition for reductions in reliance on auditory feedback would require repeated practice on a given, limited speech task.

The results of this study may be further considered in terms of the verbal planning concept of Goldman-Eisler (1968). It could be argued that repeated practice on the experimental task resulted in improvements in those central nervous system processes which guide speech. The significantly lower reading times and significantly lower articulation error scores for practiced subjects under DAF supports this type of hypothesis. However, observations made in our laboratory subsequent to the completion of the present experiment have shown that normally fluent speakers who softly whisper the reading passage six times and read it aloud under DAF on the seventh, perform at approximately the same level of articulation errors and reading times as nonpracticed subjects who experience DAF on the first oral reading trial. Thus, it is tentatively concluded that a concept other than that of verbal planning must be invoked to explain the results. Apparently, verbal planning was not strengthened by whispered practice. It does appear as if auditory and kinesthetic cues associated with normal vocalization play a prominent role in producing the effects which have been observed. At the present time, the most tenable and apparently least complex interpretation of the results reported here is that oral reading practice yielded temporary changes in the subjects' use of auditory feedback cues.

Finally, although such a suggestion is somewhat tenuous at the present time, it may be useful to consider the possibility that the phenomenon of stuttering adaptation may involve temporary changes in the sbujects' relative reliance on auditory feedback cues. The hypothesis merits consideration for an interpretation of stuttering adaptation because it provides a parsimonious means of accounting for the basic shape of the typical adaptation curve, for the "spontaneous recover" of stuttering following adaptation, and for a number of the other effects which have been observed in studies on this phenomenon (Wingate, 1966a,b). In addition, this type of hypothesis would lead us to determine the nature of basic processes which may be involved in speech guidance in both normally fluent speakers and stutterers.

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Appendix D

Photocopies of _New York Times_ Article
and _Newsweek_ Article

THE NEW YORK TIMES, MONDAY, MARCH 27, 1972

Virginia Psychologist Treats Stutterers by Computer-Assisted Therapy, but Some Experts Voice Doubt

Special to The New York Times

ROANOKE, Va., March 24 —For half her life, since she was 17 years old, Sue Wolff had been seeking a treatment for a problem that had bothered her for as long as she could remember — her stuttering.

Mrs. Wolff, herself a speech pathologist, had spent a total of seven years in three different programs of speech therapy and — with her young son, who was also a stutterer—she had spent more than a year in the care of a psychotherapist. But nothing had "worked."

Then last fall she and her son, on the recommendation of the psychotherapist, joined a program with a "mechanical" approach at Hollins College, a small women's school here, and since the 10th day of their training neither Mrs. Wolff nor her son has stuttered again.

The developer of the Hollins program, Dr. Ronald L. Webster, maintains that his computer-assisted therapy can turn most stutterers—there are some two million in the United States — into normally fluent speakers within two to three weeks.

But the views of Dr. Webster, who received his Ph.D. degree from Louisiana State University and is chairman of the Hollins psychology department, are sharply challenged by many other experts interested in research on stuttering.

Theoretical Division

Roughly speaking, the theoretical division is this:

On one side are those who like Dr. Webster feel that stuttering can be treated as a problem in its own right, with little or no reference to anything else.

And on the other hand are those who hold that stuttering is a manifestation of deeper psychological problems, which, if not treated directly, may resurface with the same or different and possibly even worse symptoms.

According to Dr. Webster, the success of his methods is supported by hard evidence. Of 55 people who have completed the program since 1969, he said in an interview, "about seven out of 10 have retained high levels of fluency" in follow-up checks, generally two years later.

"In more than half the cases," he said, "we have gotten very positive reactions from the people themselves, and we observe excellent fluency patterns."

The checks were performed through a combination of telephone conversation and tape recorded samples of specific speech tasks in cases where the person was unable to return to the college for face-to-face observation.

Dr. Webster's program of therapy, discounting attitude-oriented approaches that concentrate on emotional factors, seems to teach stutterers the specific and precise movements necessary to produce the various distinct sounds of American English.

"If the stutterer acquires specific skills," he said, "then he can sustain fluent speech." The training becomes the person's natural speech pattern, he added, "so it does not have to be used as merely a control."

Operating with $68,000 in research grants from the United States Office of Education, Dr. Webster has also been exploring a theory that stutterers suffer from a malfunction of two muscles of the middle ear causing "interference with the sound of the voice as a guiding cue for speech." He entered into the study of stuttering by way of earlier research into language development in infants.

Focusing his attention on "overt, observable aspects of speech behavior," Dr. Webster has identified, he says, several distinct characteristics of stuttered speech: Initial sounds are too loud, individual speech sounds are too short, the transitions from one sound to another are too quick.

His training concentrates on slowing down the rate of speech and softening the initiation of sounds, techniques that may compensate for the middle ear interference. At first, both techniques are highly exaggerated.

In the tiny sound-proof cubicles where most of the laboratory work in the Hollins program is carried out, the student, riveting his eyes on the sweep second-hand of a timer, practices conversing with the instructor, limiting his speed to one syllable every two seconds.

The process of softening and smoothing the sounds is even more difficult to teach. Tagged "gentle onset" by the therapists, the effect is somewhat like sneaking into the sounds by beginning very, very softly and gradually increasing volume.

The student practices "gentle onset" by speaking single syllables into a computer, the latest innovation in the six-year development of the program. The refrigerator-size machine responds by judging whether the sound has been made correctly and signaling —with a terse, typed "O.K." —to move on to the next sound.

THE NEW YORK TIMES, MONDAY, MARCH 27, 1972

Accent Is Unchanged

Proceeding systematically from sounds to words to sentences and then to fluent conversation within the laboratory, the student finally takes his newly fluent speech into his everyday life. Personal speech traits such as accent are unchanged, Dr. Webster says, except in amplitude and duration of sounds.

"Most therapies that have been taught since the mid-thirties in this country have focused on teaching the stutterer how to adapt to the fact that he stutters," he says. "They've tried to 'free-up' stuttering so that talking comes easier, but the disfluencies are still there."

This is "putting the cart before the horse," he went on. "The stutterer's feelings are the result of the fact of disfluency. We teach a person directly how to make the sounds of speech properly, because then he can speak even under stress. It's not normal to be always relaxed."

Several leading researchers in the theory and treatment of stuttering, reached by telephone, said that Dr. Webster's mechanical approach appeared similar to a great deal of work that has been done over many years. They questioned the premise that stutterers do not make the sounds of speech correctly.

Lee Edward Travis, dean of the Graduate School of Psychology at Fuller Theological Seminary in Pasadena, Calif., after 45 years of study is firmly established in the psychotherapy school.

Stuttering is a disorder of a bad relationship between the speaker and his listener," he asserted. "A stutterer can talk as well as anyone else, except when he has a listener. He tends to give the listener too much importance, control, wisdom, harshness. Therefore, he carries in his speech the load of how he is being evaluated."

"If Webster is getting results," he said, "they are indirect."

'I Think They Are Folly'

Harold L. Luper, head of the department of speech and audiology at the University of Tennessee and a former stutterer himself, held a similar view:

"I think what really is happening," he said, "is that he's changing a whole motor set toward speaking," eliminating a stutterer's tendency to tighten up before talking and substituting a different kind of "set" that permits more fluent speech.

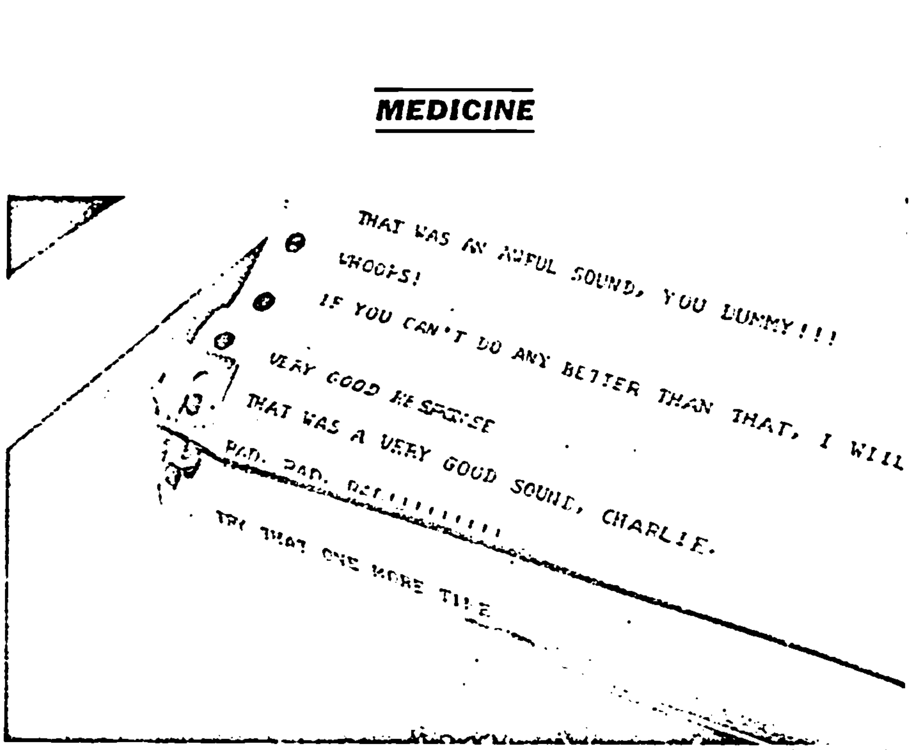
Joseph G. Sheehan, a clinical psychologist at the University of California at Los Angeles, was skeptical of behavior modification therapies in general. "I think they are folly," he insisted.

Professional opinions notwithstanding, a number of Dr. Webster's former students—ranging from a high school dropout to a military officer—were quite happy with the results achieved in his program. Most of them had previously undergone various forms of speech and psychotherapy.

Dr. Webster cited a major in the Army who became convinced he could rise no further because of his stuttering and was considering quitting the service. But after three weeks of therapy, Dr. Webster said, the officer was placed on the promotion list and attended command school, where he achieved the highest ratings in oral presentations. Now the officer is a lieutenant colonel, Dr. Webster said, third in command of a large base in Europe.

And Sue Wolff, a speech therapist with the Easter Seal Treatment Center in suburban Washington until her family moved recently to Alabama, said that the Hollins program had been "much more consistently successful" than traditional therapies and that she intended to use it as a model for her own practice.

"You learn a skill, learn how to speak," she said, "and when you know how to talk you don't have to think about it. I'll be a much better therapist because of it."



Robert Phillips—Roanoke Times

Bob Crawford

Fluency shaping: Webster (left) with computer co-therapist; right, early examples of computer responses

New Help for Stutterers

Six years ago, Mrs. Collins Denny III of Richmond, Va., took her 5-year-old son, Bill, to the Medical College of Virginia to see if something could be done to correct his severe stuttering. No, she was told, there was really no good treatment for such speech disorders, except to try to relieve tensions in the home. But Mrs. Denny refused to give up—and last week Bill returned to MCV to offer dramatic proof that stuttering can be cured after all. He took the platform before an assemblage of speech therapists and, with perfect enunciation, described in detail the three-week "fluency-shaping program" he had received at Hollins College in Roanoke, Va.

The program that cleared up Bill's stuttering was conceived by Dr. Ronald L. Webster, 34, chairman of the Hollins psychology department. Traditionally, stuttering has been blamed largely on deep-seated emotional problems, and treatment has usually been directed toward uncovering some psychic trauma. But Webster's research convinced him that if anxiety had anything to do with stuttering, it was the result of the disorder rather than the cause.

Feedback: Stuttering, Webster believes, is a behavioral problem based on faulty learning of how to make sounds, and perhaps also on physical defects in the auditory mechanisms controlling speech. Speech, he explains, is regulated by feedback mechanisms. The muscle movements involved in speaking, according to this concept, are detected by sensors in the ear and in the muscles themselves and then relayed to the brain to guide further speech movements. Webster has shown that a normal speaker can be made to stutter by interfering with feedback. In his experiments, a special tape recorder returns speech sounds to the speaker's ear after a two-tenths-of-a-second delay. The delayed feedback disrupts the subject's speech rhythm and reduces the accuracy of articulation.

Additional research has also led Webster to conclude that stutterers may suffer from abnormal movement of the two muscles in the middle ear that are involved in the process of hearing. In normal speakers, says the Virginia psychologist, these muscles contract just before each speech sound is initiated. But in stutterers, they seem to contract at about the same time that a sound is initiated. Contractions of the muscle cut down on the intensity of sound reaching the inner ear. The effect of delayed contractions, Webster believes, is to cut out part of the auditory feed-back signal required for normal speech.

Fast: Webster has found that stutterers tend to make sounds incorrectly, especially at the onset of a new sound. They are apt to begin a sound too abruptly and too loudly and make transitions from one sound to another with excessive speed. The fluency-shaping program, developed over the past six years, is designed to retrain stutterers in the making of speech sounds. The program is intensive, requiring four to seven hours of drill each day. But it gets results fast—the average patient completes the course in two or three weeks.

In the first phase of treatment, the stutterer is instructed to slow down his speech, holding each syllable for two seconds and uttering sentences at the rate of about 30 words a minute. To learn the proper way to make sounds, he is repeatedly told to glide gently into each syllable—a process Webster terms "gentle onset." He practices first on the enunciation of vowels, usually the easiest for a stutterer to enunciate. Then he proceeds to vowel-like consonants, such as l, r, and y, fricative sounds like f, s, and th, and finally, to the difficult stop consonants such as p, b, and k. As he progresses, the patient goes from single- to multiple-syllable words, and from short sentences with many vowels to long sentences filled with stop consonants. His rate of speech gradually accelerates to 100 to 130 words per minute.

Recently, Webster has enlisted the aid of a computer to act as a co-therapist in helping stutterers. The device is programed to recognize normal sound formations. As the patient speaks into a microphone, the computer compares his sounds to the reference sounds in its memory bank. When the patient achieves a good approximation, a printout tells him so. As originally programed, the computer would respond with cheery compliments like "That was a good sound, Charlie," or derisive phrases like "That was an awful sound, you dummy!" But because this method proved unsettling to many patients, the computer now rewards success with a simple "OK," and greets failure with silence. The computer has several advantages over a human therapist. It is more consistent in making decisions about minute variations in sound than is a human listener; and because he is not distracted by the presence of another person, the patient can often progress more rapidly when drilled by the computer.

Telephone: Eventually, he hopes to program the computer to diagnose speech deficiencies in individuals and print out prescriptions for treatment based on the sounds that seem to need the most practice. More intriguing is the possibility of establishing "dial-a-therapy" networks in which stutterers could correct speech patterns by telephone contact with a computer miles from home.

The results of fluency shaping have improved as the program has evolved. Seventy-six stutterers have gone through the current program, and analysis of speech samples during normal conversation and oral reading tasks indicate that

7 out of 10 have achieved good-to-excellent speech fluency. Among twenty persons who completed the program two years ago, nineteen say their speech is better than it was before treatment.

Until more patients have gone through the program, many speech therapists remain skeptical of the Webster method. Some of them note that the use of behavioral retraining techniques to treat stuttering isn't new and that the Hollins program has simply introduced some elegant variations.

But one speech therapist who is convinced that fluency shaping really works is Sue Wolff of Fairhope, Ala. Herself a lifelong stutterer, Mrs. Wolff went through three intensive speech therapy programs, including psychotherapy, without lasting results. Last December, she enrolled in the Hollins course and hasn't stuttered since. This fall, Mrs. Wolff plans to carry the fluency-shaping message by starting a program of her own.

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DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
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TITLE

An Operant Response Shaping Program for the Establishment of Fluency in Stutterers

PERSONAL AUTHOR(S)

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INSTITUTION (SOURCE)

Hollins College, Roanoke, Virginia

SOURCE CODE

REPORT/SERIES NO.

OTHER SOURCE

SOURCE CODE

OTHER REPORT NO.

OTHER SOURCE

SOURCE CODE

OTHER REPORT NO.

PUB'L. DATE 6-30-72 — —   **CONTRACT/GRANT NUMBER** OEG-0-70-2718(607)

PAGINATION, ETC.

77 p.

RETRIEVAL TERMS

IDENTIFIERS

ABSTRACT

A systematic operant response shaping program was administered to 57 stutterers. The program restructured the articulatory skills used in speech production and transferred these skills into conversational speech. Measures of disfluent word frequencies, self perceptions of of stuttering avoidance, struggle, and expectancy, and subject satisfaction with speech fluency showed large and significant improvements as a result of program participation. Followup data collected an average of two years following completion of the program participation. Followup data collected an average of two years following completion of the program indicated that 7 out of 10 subjects had retained good to excellent levels of speech fluency. These subjects also reported satisfaction with their post-treatment levels of speech fluency. Preliminarly development was done on an on-line computer system which was used to monitor the adequacy of responses made by subjects as they worked through the fluency shaping program. The computer fed back information to the subjects after they made each speech response and indicated whether or not the responses were correct. Finally, an examination of the costs for the project indicated that it should be indicated that it should be possible to conduct fluency shaping programs on a relatively low cost per subject basis.