An Evaluation of the Regulated Breathing Method in Treatment of Stuttering

Paul B. Greilick
Western Michigan University

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AN EVALUATION OF THE REGULATED BREATHING METHOD IN TREATMENT OF STUTTERING

Paul B. Greilick, M.A.
Western Michigan University, 1983

The effects of the regulated breathing method on several characteristics of the speech of four stutterers were assessed in a multiple baseline across subjects design. Repeated measures of stuttering frequency, speech rate, and fluency rate were obtained in multiple settings before, at termination, and through six months post-treatment. Subjects' estimates of stuttering frequency were compared with objective measures of stuttering across phases. At post-treatment and follow-up, although stuttering frequency had decreased and speech rate increased substantially compared to baseline, subjects continued to stutter frequently. Additionally, subjects consistently underestimated frequency of stutters as measured by the experimenter. The efficacy of the regulated breathing method is questioned, as is the validity of using self-estimates of stuttering frequency as an outcome measure.
ACKNOWLEDGEMENTS

I am greatly indebted to Dr. Wayne Fuqua and Dr. Mick Hanley for their guidance, encouragement, constructive feedback, and active involvement in planning, executing, and documenting this research project. Their involvement has helped make this project a most significant part of my educational experience. I am also indebted to Janice Arone for her assistance in conducting numerous assessments during the study. I am further indebted to The Graduate College and The Psychology Department for financial support of the study. Finally, I would like to thank Mary. Her continued support, encouragement, patience, and active participation were invaluable.

Paul B. Greilick
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INTRODUCTION

Stuttering is a relatively common and, for many, debilitating disorder. Four percent of the general population have been stutterers at some point in their lives, with one percent continuing to stutter during adulthood (Lanyon, 1978). A variety of procedures are known to dramatically reduce stuttering for short durations in laboratory settings. These procedures include delayed auditory feedback (Goldiamond, 1965); metronomic paced speech (Barber, 1940); shadowing and masking (Cherry & Sayers, 1956); biofeedback (Davis & Dritcha, 1980); singing, and choral reading (Bloodstein, 1949). Unfortunately, extensive reviews of the literature indicate few procedures produce satisfactory maintenance and generalization of therapeutic gains (Andrews, Guitar, & Howie, 1980; Ingham & Andrews, 1973; Lanyon, 1978).

An analysis of the stuttering treatment literature suggests that substantial and lasting reductions in stuttering typically require a minimum of 80-100 hours of treatment (Andrews, Guitar, & Howie, 1980). In contrast, Azrin and Nunn (1974) reported dramatic effects from a brief package treatment emphasizing regulated breathing. They reported treatment of 14 subjects whose self-reported frequency of "stuttering episodes" showed a 94% decrease after a single 2-hour treatment session. More significantly the self-reported decrease in stuttering reached 98% at a 4-month follow-up assessment. Similar results were reported in a replication study (Azrin, Nunn, & Frantz,
1979). Unfortunately, both studies suffer a variety of methodological weaknesses, rendering the significance of these data inconclusive. Specific criticism has been related to the failure to provide an operational definition of "stuttering episodes," and the use of self-report "estimates" of subjects as a data base (Johnson, 1980). The inadequacy of self-reported measures of stuttering frequency as the primary outcome measure in stuttering research is highlighted by a recent study (Ladouceur, Boudrea, & Theberge, 1981) in which untrained stutterers correctly identified an average of only 30% of stuttering episodes recorded by the experimenter during a brief conversation.

Replications of the regulated breathing method by other investigators have failed to produce the immediate and dramatic reduction in stuttering frequency reported by Azrin and his colleagues (Azrin & Nunn, 1974; Azrin et al., 1979). In two case studies, in which the regulated breathing method was the primary intervention, frequency of self-reported out-of-clinic stuttering decreased significantly after 9 or more sessions (as opposed to one or two) (Jones, 1981; Small, 1975). These reports suggest that greater time may be required than originally reported by Azrin et al. (1979) to successfully implement the regulated breathing method.

Subsequent to the inception of the present study, several investigators have reported experimental evaluations of the regulated breathing method using objective outcome measures (e.g., measures of stuttering severity for which adequate inter-observer reliability was established). In a single-case study, Williamson, Epstein, and Coburn (1981) reported that after five sessions of regulated breathing
treatment, stuttering frequency immediately decreased to less than 10% of words spoken, while speech rate increased significantly, during speech samples recorded within the clinic. During the following three months, eight additional treatment sessions were conducted. During this period the subject periodically tape-recorded his conversations with family members within his home. During such a probe at three months, stuttering frequency averaged 2% of words spoken. The authors concluded that the additional treatment sessions were probably necessary for the maintenance and generalization of the observed treatment gains.

Andrews and Tanner (1982) assessed the effects of the regulated breathing procedure on stuttering frequency, speech rate, and attitude. Speech samples of six stutterers were obtained across three settings on several occasions pre-and post-treatment. The definition of stuttering used was that of the International Classification of Diseases (WHO, 1977). Overall, stuttering frequency was reduced from baseline by approximately 65% at 14 days, and approximately 45% at three-months post-treatment. Speech rate, and attitudes about speaking as measured by the SR24 version of the Erickson Scale (Andrews & Cutler, 1974), were not significantly changed. The authors concluded that only one subject showed evidence of clinically significant improvement, and suggested further research be conducted to determine the potential value of the regulated breathing procedure.

Ladouceaur, Boudreau, and Theberge (1981) hypothesized that systematic awareness training prior to the introduction of the regulated breathing method would significantly improve fluency in stutterers. 

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Stutterers were randomly assigned to one of two groups, awareness training followed by regulated breathing method or regulated breathing method only. Awareness training involved teaching stutterers to self-monitor stutters during conversation. The addition of systematic awareness training failed to significantly enhance the effects of the subsequent application of the regulated breathing method.

At post-test and one-month follow-up, frequency of stuttering (as defined by a) hesitation before completing a word or a syllable, b) prolongation of a syllable, c) repetition of a word or part of a word, or d) blocking) was reduced by about 50% from baseline for both groups. However, observed dysfluency level was about 5%, a level which is typically used to identify or categorize persons as stutterers (Webster, 1979). The implication of the data for generalization and maintenance of treatment effects are unclear since all pre- and post-treatment data were gathered by the original therapist and in the original setting, to which subjects may have habituated. In a follow-up study, Ladouceur, Cote, Leblond, and Bouchard (1982) evaluated three types of systematic awareness training procedures as adjuncts to the regulated breathing method, two of which included biofeedback. Subject's speech was sampled obtrusively and unobtrusively during telephone and laboratory interviews on several occasions pre- and post-treatment. A statistically significant reduction in stuttering frequency (about 50%) was observed post-treatment. At a two-month follow-up, frequency of stuttering had increased significantly. The authors concluded there was no significant clinical improvement over baseline at two-months and therefore, conducted no
further follow-up assessments. The addition of awareness training procedures failed to enhance the effectiveness of the regulated breathing procedure. An inverse relationship between speech rate and dysfluency level was evident.

Cote and Doucet (1982) evaluated the effect of 'social aids' as an adjunct to the regulated breathing method. Subjects were assigned to one of three groups; control, regulated breathing only, or regulated breathing plus social aid, in which stutterers received treatment in the presence of a significant other. The subject and significant other were trained and instructed to perform exercises between treatment sessions. Speech was sampled during telephone and laboratory conversation under obtrusive and unobtrusive conditions. Results indicated that the 'social aid' procedure failed to enhance the effectiveness of the regulated breathing method. Both experimental groups showed statistically significant reductions in stuttering frequency at post test and 6-month follow-up. However, experimental subjects did not achieve significantly greater fluency than control subjects. Rate of speech increased at post test and returned to pre-test level at follow-up for all groups. The relation between stuttering frequency and speech rate was not established.

The above applications of the regulated breathing method have consistently demonstrated statistically significant reductions in stuttering, but the results have been much more modest than those reported by Azrin et al. (1979). After treatment and follow-up, the frequency of stuttered syllables have generally exceeded 5% of syllables spoken. Furthermore, the introduction of various types of
systematic awareness training procedures have failed to significantly enhance the effectiveness of the regulated breathing procedure. To account for the large discrepancy between Azrin et al.'s (1979) data and those obtained in other laboratories, investigators have questioned the validity of the self-estimates used in Azrin's studies. To date however, the accuracy of stutterer's self-monitoring over an extended time period has yet to be systematically evaluated. It remains unclear to what variables stutterers respond to in formulating their self-estimates of stuttering frequency, or what potential value these estimates have in treatment outcome evaluation.

It appears that certain stutterers benefit greatly from brief regulated breathing treatment (Andrews & Tanner, 1982). Unfortunately, many of the replication studies have used group designs in which individual subject data are obscured by group averages. Thus, it seems single subject design methodology would, at least initially, provide a meaningful and possibly more appropriate approach in elucidating the reasons for individual variation in response to the regulated breathing method. Another important issue not explored in the above literature is the adequacy of using frequency of stuttering as the only or primary means of estimating severity of stuttering. The occurrence of a single severe block (characterized by extreme tension, struggle, or duration) is sufficient to label a person 'uncured' even though treatment may have reduced frequency of stuttering by 99% (Andrews & Craig, 1982). Thus a measure of duration of stuttering moments is valuable in evaluating fluency. Some estimate of changes in the duration of stuttering moments can be inferred from changes
in the measure of speech rate reported in the previously reviewed studies. Unfortunately, the accuracy of such estimates is limited since speech rate is also subject to influence by variation in articulatory rate and length of pauses between phrases (Perkins, 1975). Furthermore, articulatory rate, which can vary independently from speech rate (WPM), may have an important effect on stuttering frequency, and its potential contribution to changes in fluency should be specified in any description of stuttering treatment. Thus, it is unclear whether the increased speech rate and decreased stuttering frequency reported in the previously reviewed literature were associated with a decrease in stuttering duration (intensity), and/or mediated by a decrease in articulatory rate.

The purpose of the present study is to further evaluate the efficacy of the regulated breathing method, and the criteria used to measure therapeutic outcome. Individual variation in response to treatment was highlighted through the use of a multiple baseline evaluation of treatment across subjects. The relationship between changes in rate of fluent speech, overall speech rate, and stuttering frequency was also explored. Reliability of stutterer's self-estimates of stuttering frequency over time was assessed by comparing subject's estimates with experimenter's analysis of stuttering frequency on speech collected across phases of the experiment. Maintenance and generalization of treatment gains were assessed by repeated measures across time and diverse settings respectively.
METHOD

Subjects

Subjects were four stutterers (3 male, 1 female) who responded to a newspaper advertisement offering experimental treatment for stuttering. Each subject was paid 30 dollars for his/her participation in the study. Subject 1 was a 23 year old male student of speech pathology at a midwestern university. He had received previous speech therapy at several points in his life, the results of which he reported to be inconsequential. His speech was characterized by frequent repetitions and tense pauses (abnormal hesitations).

Subject 2 was a 14 year old male who had received speech therapy of approximately 18 months duration 2 years prior to the study. He reported that his therapy had been temporarily beneficial but that his stuttering had since returned to pre-treatment level. His speech was characterized by frequent repetitions, prolongations, and by tense pauses.

Subject 3 was a 62 year old female who had stuttered since childhood, but had never received speech therapy. A right hemispheric stroke, which occurred approximately 10 years prior to the study, left her mute for several months, after which time her speech returned to pre-stroke quality. At the beginning of the study her speech was characterized by frequent repetitions, and severe tense blocks, accompanied by intense struggle and extreme laryngeal tension characteristic of another speech disorder, spastic dysphonia.
Subject 4 was a 15 year old male who had never received speech therapy. His speech was characterized primarily by tense pauses, and repetitions of sounds and words.

Apparatus

Video tape equipment was used for data collection and training of subjects. Portable audio cassette recorders, tapes, and notebooks were supplied to each subject for data collection outside the clinic setting. A stopwatch was used in timing speech samples.

Speech Measure Definitions

Stuttering

In accordance with Wingate's (1976, p. 99) specification of the 'primary' characteristics of stuttering, a "stutter" was defined as any occurrence of an audible word or part-word repetition, an audible prolongation, a silent prolongation, or audible activity indicating tension or struggle.

Interjections

In addition to primary characteristics of stuttering, Wingate's definition includes accessory features. Accessory features include a class of verbal behaviors referred to as "interjections". These are expressions of one to several units in length, such as 'uh, um, oh, you know', which are judged to be contextually inappropriate. Interjections were classified as a separate dependent variable.
because they can potentially be a device used to avoid or postpone dysfluent moments.

Dependent Variables

Dependent variables included direct measures of speech derived from the analysis of audiotaped and videotaped speech samples, estimates of dysfluency level based upon subject's self-monitoring, and a measure of attitude change. The first 110 words of each taped speech sample was the basis of the derived speech measures.

Speech Rate

Two types of speech rate were computed, one which included, and one which excluded, moments of stuttering. A stopwatch was used to time speech samples. The elapsed time for uninterrupted (monologue) speaking/reading was divided into the number of words in the sample. A word was defined as any unit of speech that could be written as a single word. If a word was repeated, it was not counted more than once. This method of computing speech rate was referred to as overall words per minute (O-WPM). Thus, moments of stuttering were included in the computation of O-WPM. To obtain a measure of speech rate stability across experimental phases uncontaminated by duration of stuttering moments, fluent words per minute (F-WPM), was computed as the rate of speech during fluent segments of each Subject's speaking and reading during the initial baseline and the six-month follow-up HOME probes (see data collection procedures).
Frequency of Stutters and Interjections

To account for the possibility of multiple stutters per word or per syllable, the total number of stutters per sample was tabulated, and expressed as the number of stutters per 100 words spoken or read (ST%). Therefore, stuttering frequency could exceed 100% of words spoken. Each occurrence of sound, syllable, word, or phrase repetitions were counted as a single stutter. The number of interjections within each speech sample was expressed as a percentage of the total number of words spoken (I%)

Self-Report Data

Azrin et al. (1974; 1979) relied primarily upon self-report data to evaluate their regulated breathing method. Self-report data were also collected in the present study to provide a comparison between self-estimates and objective measures of stuttering frequency. Subjects recorded two self-estimates of daily stuttering frequency: an estimate of stutters emitted during that day's taped phone conversation, and an estimate of that day's total stutters (per Azrin), a figure which was to include the phone conversation. Correlation coefficients were later computed between subject's estimates and experimenter's analysis of the phone conversations. The SR24 version of the scale of Communication Attitudes was administered pre- and post-treatment (Andrews & Cutler, 1974). Finally, per Azrin et al. (1979), a family member or other cohabitant of each subject was interviewed post-treatment to provide further observational data on speech fluency.
Data Collection Procedures

Subject's speech was sampled across phases of the experiment within five settings, four of which were not associated with the treatment site.

Clinic (CLINIC) Assessment

The CLINIC assessment involved audiotaping subjects speaking and reading immediately before and after the regulated breathing intervention. For the reading sample, which always preceded the speaking sample, subjects read a passage from a speech manual in the presence of the experimenter. The experimenter then prompted the subject into a brief monologue about his/her work or school related activities (Iowa Job Task) (Johnson, Darley, & Spriestersbach, 1963, p. 204).

Video (VIDEO) Assessment

Subjects were scheduled to meet with a speech clinician at a separate clinic; neither of which were connected with the intervention site, for the VIDEO assessments. Subjects were unfamiliar with this clinic environment. Subjects were videotaped through a one-way mirror while reading, then speaking (Iowa Job Task) in the presence of the speech clinician. Five VIDEO sessions were conducted per subject; twice during baseline (separated by one week), and then at five days, one month, and six months post-treatment.
Home (HOME) Assessment

Further samples of out-of-clinic speech were obtained through audiotaped samples of reading and speaking within the subject's home. In the HOME condition a female interviewer arrived at the subject's residence at a pre arranged time to conduct the probes (reading and Iowa Job Task). The interviewer's only contact with subjects was during the probes. Five HOME probes were conducted per subject.

Phone (PHONE-E & PHONE-S) Assessments

Subjects taped their speech during daily phone calls which were initiated at least 10 days prior to intervention and continued for at least 10 days post-intervention. Subjects continued to tape intermittent phone calls during the extended follow-up. Subjects phoned the experimenter (PHONE-E) every other day, during which they briefly described their daily activities. On alternate days subjects recorded calls to a place of business (PHONE-S) during which they made consumer inquiries.

Training of Self-Monitoring

Following the initial baseline VIDEO probe, subjects were trained to self-monitor stuttering frequency. The therapist provided an operational definition of stuttering and demonstrated an example of each type that the subject had emitted during the VIDEO session. The subject and therapist then viewed segments of the videotape while the therapist identified "stutters" using the criteria described previously.
The subject then practiced identifying stutters without assistance, and received feedback regarding his/her accuracy. The subject and therapist then covertly monitored the subject's stuttering 'on-line' (while the subject actually spoke) until inter-observer agreement exceeded 80% during four consecutive 30-second monologues. This procedure is very similar to the 'awareness-training' procedure reported by Ladouceur, Boudreau, and Theberge (1981). Only Subject 3 (the spastic dysphonic) failed to reach criterion. Subjects were given no further feedback during the remainder of the study concerning the accuracy of their self-estimates of stuttering frequency on taped speech samples.

Intervention: Regulated Breathing

Subjects received two two-hour sessions of regulated-breathing treatment as fully described elsewhere (Azrin & Nunn, 1973; Azrin & Nunn, 1977; Azrin, Nunn, & Frantz, 1979). Components of this treatment package are briefly summarized below:

1. **Inconvenience review.** A detailed review of the inconveniences and annoyances resulting from stuttering was conducted.

2. **Awareness training.** The subject was required to stutter and to describe/identify the nature of the stutters, the associated behaviors, difficult sounds/words, and difficult situations.

3. **Anticipation awareness.** The subject was taught to be aware of cues/behaviors which preceded stutters.

4. **Relaxation training.** The subject was taught to adopt a relaxed posture, to breathe deeply, slowly, and regularly, and to use
self-instructional cues for relaxing.

5. **Incompatible activities.** Activities incompatible with stuttering included: deep and regular breathing; beginning exhalation before speaking, blending sounds into the airflow, continuing exhalation beyond speech sounds, formulating one's message while making deliberate pauses at natural points of juncture in speech, and speaking in shorter phrases. A shaping procedure, which involved initially making only one sound per breath, was used to teach this breathing-speaking pattern.

6. **Symbolic rehearsal.** The subject practiced the breathing-speaking techniques through structured role-plays of stuttering-prone situations, speaking tasks, reading tasks, and intra-office phone conversations with the experimenter.

7. **Social support.** A family member or friend participated in the last part of the training session. The subject explained the nature and rationale of the procedures to the family member in the presence of the experimenter. The experimenter then explained and modelled how family members could assist the subject through positive reinforcement and reminders.

8. **Post-treatment practice.** The subject was provided a notebook containing an outline summary of the procedures to be practiced, and forms on which to record daily practice sessions. These forms were periodically collected in order to encourage compliance to home practice.
Experimental Design

A multiple-baseline design cross subjects (Baer, Wolf, & Risley, 1968) was used to assess the impact of regulated breathing upon the dependent variables.

Interobserver Agreement of Speech Measures

A total of 251 speech samples were taped within the various assessment conditions. Ten percent of each subject's samples were randomly selected and reanalyzed to determine frequency of stuttering by an independent observer. Percent agreement of stuttering was computed by dividing the smaller score of each sample by the larger. Average inter-scorer agreement was 86%, 83%, 50%, and 86% for Subjects 1-4 respectively. Low inter-scorer agreement scores for Subject 3 (the dysphonic) resulted from difficulties with the discrimination of the termination of one 'struggle' and the initiation of the next. In her case, WPM seemed to provide a better index of the severity of dysfluency than ST%. To obtain intraobserver reliability of stuttering frequency, the experimenter reanalyzed a random sample of 10% of each subject's tapes several weeks after the initial scoring. Average intrascorer reliability for ST% was 88%, 92%, 76%, and 87%, for Subjects 1-4 respectively. Intrascorer reliability for frequency of interjections and for WPM exceeded 90% for all subjects.
RESULTS

Figure 1 illustrates ST% of each subject within three settings; CLINIC pre- and post-treatment; and during VIDEO and HOME probes, pre- and post-treatment and follow-up. Examination of Figure 1 reveals that Subjects 1, 2, and 4 together averaged an 80% reduction (range 70% to 86%) in ST% during both speaking and reading in the CLINIC immediately following treatment. However, Subject 3 showed a smaller reduction in ST% (58%) while speaking, and no decrease during reading.

Greater intersubject variability is evident in HOME and VIDEO settings. Subject 1's ST% was normal (3%) at one-month follow-up during both VIDEO and HOME probes, though a slight increase in ST% while speaking is evident at 6 months in both settings. Subject 4's ST% decreased to normal (3%) by 6 months during both VIDEO and HOME probes. Subjects 2 and 3 evidenced less dramatic reductions in ST%. At six months, ST% was decreased approximately 63% while speaking and decreased approximately 70% while reading during VIDEO and HOME probes for Subject 2. For Subject 3, wide variability in ST% at 6 months is evident in VIDEO and HOME probes. Her average decrease in ST% across these settings was approximately 50% (range 26% to 76%) at 6 months. Significantly, her 0-WPM during 6-month VIDEO probe was increased 70% over baseline, reflecting dramatic reductions of intensity and duration of stutters.

Figure 2 illustrates ST% and corresponding 0-WPM during phone
Figure 1. No. stutters per 100 words (ST%) per subject while speaking and reading within probe settings CLINIC, VIDEO and HOME, during baseline, post-treatment, and follow-ups. In cases of multiple probes within a phase, "Ts" indicate range of ST%.
Figure 2. No. stutters per 100 words (ST%) and speech rate (0-WPM) during PHONE-E and PHONE-S probes, per subject, across phases.
conversations with strangers (PHONE-S) and with experimenter (PHONE-E) across experimental phases, for each subject. Examination of Figure 2 reveals several notable phenomena during baseline. Each subject's speech is characterized by frequent stutters, and for Subjects 1-3, abnormally slow 0-WPM. ST% is generally higher during PHONE-S than during PHONE-E for all subjects. Adaptation during baseline, as evidenced by trends of decreased ST% and increased WPM, was shown by Subjects 2 and 3. Specifically, Subject 2 evidenced increasing fluency during baseline PHONE-S (he failed to complete further PHONE-S calls because of reportedly high "anxiety" associated with this task). Subject 3 showed clear evidence of increasing fluency during PHONE-E beginning three days prior to intervention.

Further examination of Figure 2 reveals considerable intersubject variability during post-treatment and follow-up. For Subjects 2-4, it appears that treatment did not immediately result in significant gains in fluency during PHONE conversations. Subject 3 evidenced increasing fluency during PHONE-E, which contrasts with a concomitant increase in ST% during PHONE-S (She also reported greater anxiety during PHONE-S). Subject 4 shows an immediate and substantial reduction in variability of ST% across time post-treatment.

Subject 1 evidenced normal fluency during PHONE-E and PHONE-S on days 9-15 post-treatment, during which ST% averaged 3%. Compared to baseline, ST% was reduced 84%, while 0-WPM increased 26% during this period. During the six month probes however, his ST% and WPM approached baseline levels. In contrast to Subject 1, Subjects 2-4 generally show greatest improvement during follow-up assessments.
For subjects 2-4, during PHONE assessments made on or after week 25 (6 months): average percent decrease in ST% from baseline was 61% (range 60% to 64%) for PHONE-E, and 46% (range 39% to 50%) for PHONE-S. Concomitantly, average percent increase in P-WPM was 43% (range 21%-73%) for PHONE-E and PHONE-S together.

In sum, all subjects continued to stutter during six month follow-up PHONE probes. For subjects 2-4, ST% decreased approximately 50%, while 0-WPM had increased substantially, compared to baseline. Rate of fluent speech (F-WPM) was relatively stable (increased by an average of 16% during follow-up) compared to percent change of 0-WPM and ST%.

Table 1 displays Pearson correlations for PHONE data from Figure 2 between; 0-WPM and ST%, ST% and 1%, and Subject's self-estimate of ST% and ST%. Examination of Table 1 reveals high negative correlations between 0-WPM and ST% for most subjects, which is not surprising as stuttering is a time consuming activity. ST% and 1% correlated positively for Subjects 2-4, reflecting a decrease in 1% post-treatment. Subject 1, however, showed a slight increase in 1% post-treatment. For Subjects 1 and 2, self-estimates of ST% co-varied strongly with ST% for PHONE calls. Subjects consistently underestimated ST%, except Subject 2, who consistently overestimated ST%.

Table 2 summarizes subjects' estimates of total number of stutters emitted daily. It appears only Subjects 1 and 2 made daily estimates of stuttering frequency that could be considered realistic. Interestingly, these are the Subjects who made reliable estimates of ST% during PHONE assessments. For 3 subjects, post-treatment
Table 1

Pearson Correlations between measures from PHONE probes; ST% and 0-WPM, ST% and 1%, ST% and Subjects' self-estimates.

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<td>4</td>
<td>-.17</td>
<td>+.30</td>
<td>+.10</td>
</tr>
</tbody>
</table>

Table 2

Subjects' average self-estimated number of stutters emitted per day within treatment phase.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Baseline</th>
<th>1-14 Days Post</th>
<th>15-30 Days Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>269</td>
<td>213</td>
<td>115</td>
</tr>
<tr>
<td>2</td>
<td>567</td>
<td>471</td>
<td>238</td>
</tr>
<tr>
<td>3</td>
<td>70</td>
<td>47</td>
<td>33</td>
</tr>
<tr>
<td>4</td>
<td>31</td>
<td>32</td>
<td>26</td>
</tr>
</tbody>
</table>

self-estimates were characterized by a rather gradual decline of 50-60% from baseline, which seems to roughly correlate the pattern of decline in ST% observed during formal probes.

Table 3 displays subjects SR-24 scores. Following treatment,
Table 3
SR24 scores by treatment phase.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Baseline</th>
<th>1 Month</th>
<th>6 Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>21</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>24</td>
<td>-</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>17</td>
<td>11</td>
<td>12</td>
</tr>
</tbody>
</table>

scores of two subjects fell below the mean score of normal speakers (9), indicating substantial improvement in communication attitudes (Andrews & Cutler, 1974).

Subjects' significant others, when interviewed during follow-up, without exception reported substantial improvement in the subjects' speech. Family members typically reported that subjects were quite fluent when they remembered to apply the learned techniques. Most subjects reported receiving unsolicited reactions to their improved speech, such as "I hardly recognized your voice", and "you hardly stutter anymore."
DISCUSSION

All four stutterers in the present study evidenced substantial improvement in fluency following regulated breathing treatment. However, intersubject variability in response to treatment was considerable. For three subjects, ST\% declined approximately 80% immediately post-treatment in the CLINIC (Subject 3, the dysphonic, showed a less dramatic decline). Generalization of treatment gains tended to be gradual in some settings for most subjects. By six months post-treatment, average decrease in ST\% from baseline was approximately 65% during VIDEO and HOME probes. ST\% was typically higher during PHONE-S compared to PHONE-E. O-WPM correlated negatively with ST\%, while F-WPM remained relatively stable. Average increase in O-WPM at six months was approximately 40% over baseline. Concerning self-report data, averaged decrease in self-estimated total stutters per day was 45%. Two subjects showed high reliability across phases in estimating ST\% during formal speech probes. Finally, attitudes regarding communication, as measured by the SR24, were significantly improved for two subjects.

Although the present data confirm that regulated breathing procedures reduce the frequency of stuttering, data fail to reproduce the degree of change reported by Azrin and his colleagues (Azrin & Nunn, 1973; Azrin et al., 1979). They reported a 98% reduction after one or two sessions. In their second study, a 97% reduction was maintained at a three-month follow-up, with most subjects reporting no stuttering. In contrast, all subjects in the present study continued
to stutter after treatment. The present results are more consistent with the results of other replication studies which utilized objective measures of stuttering frequency as opposed to relying on self-report measures (Andrews & Tanner, 1982; Côte & Ladouceur, 1982; Ladouceur, Boudreau, & Theberge, 1981; Ladouceur, Cote, Leblond, & Bouchard, 1982). In these replications, the effect of treatment typically was to decrease frequency of stuttering by approximately 50%, with stuttering frequency and speech rate trending towards baseline levels at follow-up for some subjects.

The inconsistent results could be a result of several factors. First, a failure to accurately and completely replicate a previous intervention could result in inconsistent findings (Peterson, Homer, & Wonderlick, 1982). This explanation seems unlikely since the descriptions of the regulated breathing method are clear and comprehensive, and a detailed treatment manual based on prior reports was developed for this study. As far as can be determined from the publications of Azrin and his colleagues, the method was followed closely. Second, it is possible that the self-reports of Azrin's subjects were to some extent affected by unidentified treatment variables unique to Azrin's studies. For example, characteristics of the therapist's behavior, such as enthusiasm, or ability to raise client's expectation for therapeutic success, have been shown to influence the efficacy of behavior-change procedures (Frank, 1961). A third factor which may account for the inconsistent results is subjects' failure to engage in the assigned home practice of regulated breathing exercises. In the present study however, subjects reported a high degree
of compliance in conducting these daily exercises for at least one month post-treatment. Another possibility is that the subjects in this study were particularly resistant to therapy. This may indeed be the case for Subject 3 (the spastic dysphonic). However, given Azrin's subject selection procedure and the selection procedure of this study, it is extremely unlikely that the present sample was uniquely resistant as a group.

A final variable to consider in attempting to account for the present failure to reproduce Azrin's results involves the assessment of stuttering. One major difference between Azrin's studies, and those which failed to reproduce his findings (including the present study), is the method used to estimate the severity of stuttering. Azrin and his colleagues relied on subjects' estimates of stuttering frequency. Subjects were instructed to carry data sheets on which to record "stuttering episodes", and total the frequency of stuttering at the end of each day. This self-report measure has not been validated nor shown to be reliable. Based on the data from Ladouceur et al. (1981) and the comparisons between objective and self-report measures of stuttering reported in this study, subjects can be expected to substantially underestimate the frequency of stutters counted by the experimenter. Reliance on self-estimates of stuttering frequency raises questions about the accuracy and reliability of data on which highly positive claims for the effectiveness of the regulated breathing method were based.

The present study expands on previous evaluations of the regulated breathing method in several ways. First, the present study
assessed the relationship between subjects' self-estimates and objective measures of stuttering frequency over multiple sessions. Results indicated two subjects' estimates were highly correlated with objective measures of ST% for PHONE probe speech. These data suggest that some stutterers may be trained to provide reliable estimates over time of stuttering frequency for brief conversations which occur within certain standardized settings. Nevertheless, the accuracy of these self-reports should be frequently assessed by comparing them with objective measures, and thus the utility of self-estimates as a dependent variable in stuttering research may be limited. Concerning subjects' self-estimates of total stutters emitted daily, post-treatment estimates averaged a 45% decrease which occurred gradually. There is no evidence that these estimates are reliable or valid indicators of stuttering frequency, as measured by the experimenter. On the contrary, two subjects probably made gross underestimates of total stutters emitted daily as evidenced by comparing these estimates with the number of stutters emitted during one-minute PHONE probes. The potential usefulness of this type of self-report data remains to be established. It remains unclear what variables control the stutterer's estimate of stuttering frequency. In formulating self-estimates, stutterers may be responding to such criteria as duration or intensity of stutters, degree of subjective anxiety, type of stutter, or situational variables, as opposed to, or in addition to, the simple frequency of stutters. It seems that the parameters of quantification used by the stutterer must be described before interpretation of their judgments of frequency of occurrence can be meaningful.
Concerning speech rate, most subjects in the present study evidenced a high negative correlation between O-WPM and ST%. Other investigators have also observed significant increases in speech rate following regulated breathing treatment (Williamson et al., 1981; Cote & Ladouceur, 1982; Ladouceur et al., 1982). In previous replications it was not determined whether this increase in speech rate reflected a decrease in stuttering duration. In the present study, rate of fluent speech (F-WPM) was sampled and found to be commensurate with the fluency rate of normal speakers (Johnson, Darley, & Spriesterbach, 1963, p. 203), and stable across phases of the experiment relative to changes in O-WPM and ST%. These data suggest that decreased duration of stuttering was a major factor in the substantial increases of O-WPM following treatment, as opposed to increased F-WPM. The combination of O-WPM and F-WPM provided a valuable adjunct to ST% in the estimation of stuttering severity, at least insofar as durational variables contribute to severity. This was particularly evident for Subject 3 (the dysphonic), whose O-WPM increased 70% over baseline during some probes.

Generalization of treatment effects beyond the CLINIC setting was not immediate for most subjects. Except for Subject 1, ST% showed a gradual decline across repeated measures in the HOME, VIDEO and PHONE probes. This function, while possibly indicative of treatment effects or continued practice of regulated breathing techniques, is also commensurate with findings expected under habituation (Johnson & Knott, 1937). In sampling the stutterer's speech, it is difficult to separate the effects of treatment from the effects of adaptation.
to the stimuli associated with the assessment procedures. However, data reported by Andrews and Craig (1982) suggest that the differences in stuttering frequency across overt and covert assessments may be minimal for most stutterers. In the present study, repeated measures of subjects' speech in out-of-clinic settings indicated that, although some habituation occurred during baseline, the greatest improvements occurred following treatment. Furthermore, subjects' conversations with total strangers or confederates were the major source of speech samples. Therefore, adaptation may have been a less significant factor in decreased ST% compared to several previous evaluations of regulated breathing.

In sum, the present study failed to reproduce the results reported by Azrin and his colleagues. Subjects continued to stutter at post-treatment and follow-up. Nevertheless, observed reductions in frequency and inferred duration of stuttering was substantial following treatment. Because the regulated breathing method is much briefer and potentially more cost-effective than other treatment programs, further research should be encouraged to develop ways to enhance its efficacy. Such research should be based upon current perspectives of communicative interaction, the significant variables underpinning those interactions, and their relationship to stuttering. It is likely that stuttering moments are the function of the contribution of multiple interacting variables (e.g., environmental cues, autonomic arousal, learning history). Furthermore, it has been hypothesized that the relative contribution of these variables, in the breakdown of speech-motor coordination, changes across situations and across stutterers
(Hanley, 1982; Zimmerman, Smith, & Hanley, 1981). Thus in a given case, the value of a particular treatment technique may depend on the unique combination and "weighting" of such contributing variables. Thus, an individually tailored treatment approach, which is based upon a comprehensive descriptive and functional analysis of the relationships between the stutterer and his/her unique communicative environment, may prove more effective than the application of a standard 'package' treatment.


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