AN ANALYSIS OF A TOKEN ECONOMY IN STUTTERING THERAPY¹

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A stuttering therapy program in which adult stutterers were hospitalized and treated in small groups ($n = 4$) under token economy conditions is described. The Token System reinforced reductions and penalized increases in stuttering during conversation. The therapy program was divided into three stages. Initially, subjects were treated by the token system, which was then integrated with a delayed auditory feedback schedule designed to instate and shape a prolonged speech pattern into normal fluent speech. Finally, subjects passed through a speech situation hierarchy while under token control conditions. Experiments conducted in the first two stages of treatment are described. The first-stage experiments examined the design of the token system; the second-stage experiment assessed the effect of a contingent punishment schedule integrated with the delayed auditory feedback procedure in order to shape rate of speaking as well as fluency.

In recent years, substantial evidence has been gathered showing that stuttering behaviors can be modified by procedures derived from the operant paradigm. Martin (1968) and Siegel (1970) reviewed experimental studies demonstrating the modification of stuttering behaviors by response-contingent stimulation techniques. Shames (1969) and Ryan (1971) reported the blending of operant conditioning procedures with established therapy techniques.

One major division of operant technology has been the application of token reinforcement procedures involving delivery of tokens (convertible to "back-up" reinforcers such as toys or food) contingent upon the subject's emission of a desired behavior. A further expansion of

token reinforcement procedures in the treatment of many behavior disorders, has been the development of "token economies". In this procedure, specified target behaviors, which require modification, are continuously monitored within a scheduled environment (*e.g.*, Ayllon and Azrin, 1965). This paper reports the application of a token economy to the treatment of stuttering in adults.

Some studies (Rickard and Mundy, 1965; Browning, 1967; Leach, 1969) report the use of token systems in stuttering therapy programs, but these have been single case study reports in which stuttering was modified within short periods of therapy time. Ingham and Andrews (Ingham and Andrews, *unpublished*; Ingham, Andrews, and Winkler, 1972) reported the design and application of a token system that was integrated with Andrews and Harris' (1964) syllable-timed speech stuttering therapy program. In this program, treatment was conducted over a 9-hr period each day. The present study reports on a further extension of this treatment program wherein subjects were hospitalized and treated under token economy conditions; the token system used by Ingham and Andrews was integral in this program.

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The purpose of this paper is to describe the operation of the token economy treatment program and report a series of experiments designed to assess token control over stuttering within the program.

GENERAL METHODOLOGY

Subjects

Adult males were selected from applicants for treatment who were mainly referred by either speech therapists or medical practitioners. Ages ranged from 18 to 56 yr ($\bar{X} = 25.20$; $SD = 5.35$) but they were mainly young adults of above average intelligence ($IQ: \bar{X} = 108.4$; $SD = 12.6$). They were described as chronic stutterers who had stuttered since childhood.

Thirty nine subjects were treated in groups of four (with the exception of one group of three due to the withdrawal of one subject). They were allocated to groups according to three criteria that were assumed to aid conversation between members: they were either similarly aged or split into two similarly aged pairs; the same procedure was used to match subjects for stuttering frequency; and subjects were matched as closely as possible on scores derived from an intelligence measure (A.C.E.R., 1962).

Speech Behavior Measures

Two indices of speech behavior were employed; percentage of syllables spoken that were stuttered (%SS), and rate of speech in spoken syllables per minute (SPM). These measures were made by speech therapists, or raters, who counted each syllable spoken as either fluent or stuttered. A moment of stuttering was defined as "any effortful repetition of a sound or syllable, a block, prolongation or any effortful emission of a syllable". This definition is similar to the principal features of stuttering as defined by Wingate (1964). The SPM score was obtained from the total time that the subject was recorded as speaking without interruption from another speaker; this measure thus included pauses and speech.

Treatment Methodology

The treatment program for each group lasted approximately 21 days and was divided into three stages. During Stage A, subjects were treated by the token system. In Stage B, the Token System was combined with a graded delayed auditory feedback (GDAF) schedule designed to instate and shape a prolonged speech pattern. Stage C was designed to aid generalization of fluency obtained within the laboratory during Stage B, by having subjects pass through a hierarchy of speech situations under token system conditions.

A principal feature of the treatment program was the Rating Session. This was a 45-min period in which each subject was required to speak a prescribed minimum number of syllables during conversation with other subjects. Raters recorded the number of syllables spoken, the number of syllables stuttered and the speaking time for each subject. These measures enabled %SS and SPM scores to be calculated for each subject at the end of a Rating Session.

An attempt was made to extend treatment over most waking hours during the patient's stay in hospital. Therefore, nine Rating Sessions were scheduled at intervals during each day; the first at 7 a.m. and the last at 9 p.m. Stage A continued for 21 Rating Sessions. During this period, subjects were treated only by the token system in Rating Sessions, but in Stages B and C, token control conditions were extended to the inter-Rating Session periods.

A description of the treatment procedure in each stage follows.

Stage A

This stage occupied the first 21 Rating Sessions. At the end of the session, each subject was either rewarded or penalized tokens according to his %SS score and relative to his "baseline" %SS score. Initially, baseline %SS and SPM scores were derived from performance on the Iowa Job Task (Johnson, Darley, and Spriestersbach, 1963) given six months before

treatment and immediately before treatment. The token system schedule rewarded a baseline %SS score in a Rating Session with two tokens, and four tokens for each one-tenth reduction in %SS compared to baseline %SS. Conversely, subjects were penalized two tokens per one-tenth increase in %SS above baseline %SS. Each subject's baseline %SS score was shifted after the consistent performance trends in Rating Sessions; when the subject accumulated either three token-earning or token-penalized Rating Sessions, then the mean score in these sessions became the baseline until superseded by a further improvement or failure trend. The details of this token system have been described elsewhere (Ingham *et al.*, 1972).

The token system was designed to assist in shaping the subject's speech towards a "target behavior" of 0%SS at speech rates of between 180 and 220 SPM. Thus, when a subject's token reinforcement schedule included zero stuttering he was then rewarded (if necessary) for increasing his SPM rate to the target range. The penalty schedule in the token system was designed to reduce "giving up" behavior that could occur if a subject recognized he was unlikely to earn tokens within a Rating Session. In summary, therefore, subjects were contingently token rewarded or penalized for corresponding reductions or increases in two response-classes: firstly, percentage of stuttering and subsequently rate of speech.

Stage B

In this stage, the token system and Rating Sessions were combined with a delayed auditory feedback (DAF) therapy procedure derived from Curlee and Perkins' (1969) "Conversational Rate Control Therapy". The procedure used incrementally graded delayed auditory feedback and followed a schedule adapted from reports on this procedure by Goldiamond (1965) and Curlee and Perkins (1969)³

At the beginning of this stage, subjects were instructed to speak constantly with prolonged vowel sounds and smooth transitions between each speech sound. Initially, to assist use of this speech pattern, all subjects spoke in Rating Sessions under DAF conditions and with a 250-msec delay level. The speech signal was directly transmitted to other subjects so that Rating Session conditions could obtain. Each subject was required to speak a sequence of four stutter-free Rating Sessions (two with DAF and two without assistance from DAF) before his delay level was reduced by 50 msec. Concurrently, he was required to increase the number of syllables spoken in a Rating Session, and thereby SPM rate, according to the GDAF schedule shown in Table 2. Reference to this schedule shows that subjects were penalized for departing from a target speech rate for each delay level. Subjects earned four tokens for 0.0%SS and lost a token for each 0.1%SS during a Rating Session. Prolongations were recorded as "stutters" after the 100-msec delay level was reached.

To assist further the instatement and shaping of fluent speech in Stage B, token control was extended to intervals between Rating Sessions. During these periods clinicians attempted to retain constant auditory contact with subjects who were then penalized one token for any moment of stutter, cessation of prolonged speech, or (as a group) cessation of speaking for more than 5 sec. This procedure was also continued into Stage C.

Stage C

From the "Stutterers Self-Rating of Reactions to Speech Situations" questionnaire (Johnson *et al.*, 1963) which was given to all subjects before treatment, a group of situations was identified as "avoided" by a majority of subjects. Five situations were incorporated in the program and four were easily ranked in order of "difficulty"

³This procedure was used with 23 of the 39 subjects treated in this program. The other 16 subjects were treated by syllable-timed speech (Andrews and

Harris, 1964). Since the GDAF procedure was found to be associated with less debilitating residual stutter (Ingham and Andrews, 1971) it has replaced syllable-timed speech from the current treatment program.

by all subjects in the program. They were in order of increasing difficulty conversations with (i) strangers in the hospital, (ii) with sales personnel in shopping centres, (iii) with prospective employers, and (iv) with "ladies of pleasure" in a well known locality of Sydney.⁴ Telephone conversations were intermittently scheduled throughout the last three levels of the hierarchy according to the subjects' ranking. The hierarchy required subjects to obtain 1000-syllable cassette recordings of their speech in each situation; each recording was then rated as in a Rating Session and movement through the hierarchy was contingent on subjects obtaining a sequence of two stutter-free recordings at each level.

Because the hospitalization period could be arranged for a maximum of only 21 days, the program finished when subjects completed the hierarchy or after 21 days. However, only two subjects failed to finish Stage C. Of those who completed the hierarchy before 21 days, only one subject did not remain for the rest of the program. In this time, subjects obtained additional practice in Rating Sessions and hierarchy situations.

During Stage C subjects earned four tokens for each Rating Session, or each hierarchy speech task, that was within the target range (*i.e.*, 0.0% SS at 180 to 220 SPM).⁵

Backup Reinforcers

Tokens were the means by which patients obtained the necessities and luxuries they needed while in the hospital. Each subject used a different colored token so that individual records of token income and expenditure could be maintained. Prices of meals were set so that four tokens would buy a main course at any meal, although a normal meal required up to 12 tokens.

⁴This situation was added to the hierarchy.

⁵In current programs the target SPM rate earns four tokens in a Rating Session and six tokens on an excursion: subjects are rewarded the additional two tokens for completing the minimum number of syllables required on an excursion.

Therefore in Stage A, maintenance of baseline performance (nine sessions at two tokens per session) would ensure an austere but adequate existence. Tokens were valued at five cents each and individual luxury items were priced according to their value in Australian currency. Any luxury item, *e.g.*, magazines, cigarettes, beer, *etc.*, was obtained for subjects on request and paid for in tokens according to its real currency price.

TOKEN SYSTEM EXPERIMENTS

A number of experiments were conducted within each of the stages of this treatment program. Four are reported in the present paper. The first three were conducted in Stage A and were designed to evaluate the efficacy of the token system schedule employed in Stage A. The fourth was conducted in Stage B on the procedure designed to instate and shape prolonged speech towards normal speech.

Measurement Reliability

Estimates of the reliability of Rating Session %SS and SPM scores was obtained by having the two raters independently rerate 56 samples of speech of eight subjects (from different groups) in 14 randomly selected recordings from Stage A Rating Sessions. Correlation coefficients were then calculated on between-Rater scores and with the Rating Session scores. The correlation coefficients for both %SS and SPM scores are shown in Table 1.

Table 1

Intercorrelations between raters and Rating Session scores for reliability analysis.

	%SS Scores		SPM Scores	
	R.S. Score	Rater 1	R.S. Score	Rater 1
Rater 1	0.97		0.98	
Rater 2	0.99	0.98	0.99	0.98

TOKEN SYSTEM SCHEDULE EXPERIMENTS

An important feature of the Token System employed in this program was the choice of the

response or response class. In many studies on stuttering, a "moment of stuttering" has been considered the operant and therefore the response upon which a stimulus has been contingently delivered. However, response classes, such as duration of fluency (Leach, 1969), have also been shown to behave as operants. The present study used the percentage of syllables stuttered in a defined sample of speech as a response class. Consequently, in designing the present token economy it was necessary to establish (1) the efficacy of contingent reinforcement in reducing in this response class; (2) the effect of the size of reinforcers; and (3) the necessity of penalty as well as reinforcement schedules in the design of the token system.

Method

Experiments on aspects of the Token System design were conducted during the 21 Rating Sessions of Stage A. In eight of 10 treatment groups, an ABAB experimental design was used to identify the effect of three different modifications to the token system. The other two groups formed a treatment control, *i.e.*, they were treated by the token system without variation. The experiments were arranged so that the first was conducted with two groups ($n = 8$) and the other two experiments were conducted with each of three groups (in one group $n = 11$ and in the other $n = 12$).

In the experimental groups, the 21 Rating Sessions were divided into eight, six, four, and three Rating Sessions, respectively, to form the ABAB design divisions.

The first experiment was concerned with evaluating the trend of %SS and SPM scores when the token penalty schedule was removed from the reward/penalty schedule that formed the Token System. The penalty schedule was removed during the A₁ and A₂ sections and restored during B₁ and B₂.

The second experiment explored the effect of an increase in the size of reinforcers by doubling the number of tokens that could be earned on the reward schedule. The normal schedule was

used in A₁ and A₂ and the double-tokens schedule was introduced during B₁ and B₂ of the experiment.

The third experiment assessed the effect of a noncontingent token system schedule on performance by comparison with the normal contingent token system schedule. In A₁ and A₂ sections of the experiment, subjects received four tokens for completing the minimum number of syllables required in a Rating Session, these tokens were not contingent on %SS scores. During B₁ and B₂, the contingent Token System schedule was used.

Therefore in the "B" intervals of the three experiments, it was hypothesized that (1) the combined reward/penalty schedule, (2) double-token rewards and (3) the contingent Token System, would each be associated with increases in the rate of reductions in %SS scores and increases in SPM scores when compared with the "A" intervals. By contrast, it was hypothesized that a similar trend in scores would not be found in the "treatment control group".

Results and Conclusions

The graphed results are shown in Figures 1, 2, and 3, and the performance of the "treatment control group" is shown in Figure 4.

From the figures the following conclusions were reached: (1) The penalty schedule combined with the reward schedule in the token system increased rate of reductions in frequency of stuttering and improved rate of speech, when compared with the reward schedule alone. (2) Doubling the reward value in the reward schedule increased rate of change in both speech behavior measures. (3) Noncontingent token rewards for completing the speech task did not result in changes in both speech behavior measures when they were compared with performance during operation of the contingent token system.

Therefore, changes in %SS scores over prescribed speech samples appears to be a satisfactory response class on which to establish token economy. Control over this response class within

Fig. 1. Mean %SS and SPM scores for subjects in Experiment I.

Fig. 2. Mean %SS and SPM scores for subjects in Experiment II.

Fig. 3. Mean %SS and SPM scores for subjects in Experiment III.

Fig. 4. Mean %SS and SPM scores for subjects in treatment control group.

Rating Sessions appears to be further aided by combining a penalty with a reward schedule.

The magnitude of the token rewards schedule appears to determine the rate of change, yet information on economic aspects of a token economy (Winkler, *unpublished*) suggests that an upper limit to the effect of token rewards can be determined by the likelihood of excessive savings, and a lower limit by the need to provide for basic needs. Hence, the reward schedule in this program was arbitrarily set so that maintenance of baseline performance would provide basic needs only.

GDAF SCHEDULE EXPERIMENT
INSTATEMENT STUDY

Prolonged speech can be instated with or without the use of delayed auditory feedback (Gol-diamond, *unpublished*; Watts, 1971). When freedom from stuttering (other than prolonga-tion) is first obtained by this method, a markedly slow and unusual form of speech occurs. There-fore, a major aim of this technique is to assist in shaping this slow, prolonged speech into normal speech. Accordingly, a token system schedule was designed to deliver contingent re-inforcement for successive approximations in this speech pattern to stutter-free speech at normal speed rates (Andrews and Ingham, 1971). Hence, the purpose of this experiment

was to assess the efficacy of integrating a token system schedule with the GDAF schedule for instating fluency. It was hypothesized that con-tingent reinforcement of performance on the GDAF schedule would increase the rate of passage through the schedule.

Method

The detailed schedule for the Stage B program is given in Table 2. The two groups of subjects ($n_1 = 11$; $n_2 = 12$) were matched on %SS scores before entry to Stage B. These scores were obtained from a "probe measure" of each sub-jects speech: this was a half-hour recording of subject's conversation made immediately before Stage B commenced, but outside of Rating Session conditions. Both groups were then ad-mitted to Stage B of the treatment process. The dependent variable was the number of Rating Sessions that each subject was required to pass through the GDAF schedule. One group re-ceived noncontingent tokens (four tokens for completing required syllables) during the GDAF schedule; the other group was contingently re-warded for target performance (four tokens for 0%SS at prescribed SPM rates) and penalized one token for each 0.1%SS score and departures from the previously described SPM rate schedule (see Table 2).

Table 2

GDAF Schedule Experiment: Rate of speech schedule for GDAF treatment with con-tingent token schedule. Table shows token penalties for departures from prescribed SPM rate under each delay. Subjects were also penalized one token for each stutter and rewarded four tokens for zero stuttering within the target speed range.

GDAF msec Delay	No. of Syllables Per R.S.	Slow SPM Tokens Penalized							Target SPM Range Tokens Rewarded	Fast SPM Tokens Penalized						
		-7	-6	-5	-4	-3	-2	-1		-1	-2	-3	-4	-5	-6	-7
250	400			3	6	12	18	24	30-60	66	72	78	84	90	96	104
200	600		6	15	24	33	42	51	60-92	101	110	119	128	137	146	155
150	800	6	18	30	42	54	66	78	90-124	136	148	160	172	184	196	208
100	1000	15	30	45	60	75	90	105	120-156	171	186	201	216	231	246	261
50	1000	24	42	60	78	96	114	132	150-188	206	224	242	260	278	296	314
0	1000	33	54	75	96	117	138	159	180-220	241	262	283	304	325	346	367

Results and Conclusions

The pre-Stage B scores for each individual are given in Table 3. A *t* test (Edwards, 1967) of the differences between the group means on both performance measures before Stage B was not significant (%SS: $t = 0.17$; SPM: $t = 0.56$).

The number of Rating Sessions required to complete Stage B is given in Table 3. The results showed that the "noncontingent group" ($n = 11$) took an average of 72.45 Rating Sessions to complete the hierarchy while the "contingent group" ($n = 12$) took an average of 53.42 Rating Sessions ($t = 2.41$; $p < 0.001$). Although the range of sessions required to complete this stage varied considerably, it is evident that the addition of a contingent token system appeared to shorten treatment by almost two days; this is a tenth of the total treatment time and is a significant economy in treatment.

It is difficult to evaluate clearly the effect of the noncontingent GDAF schedule within the context of the treatment program. In this study, the noncontingent group was faced with the need to proceed systematically through the

schedule, attaining zero stuttering at each delay with and then without the concurrent help of DAF. Notwithstanding that their tokens were simply contingent on completion of the minimum number of syllables, the additional criteria of performance (e.g., zero stuttering, sufficient speed of speech to complete required syllables) had to be met before subjects could progress through the GDAF hierarchy. This probably exerted additional control over their speech. But these controls were undoubtedly aided by the requirement that subjects should constantly use prolonged stutter-free speech at all times between Rating Sessions.

Neither Goldiamond (1965) nor Curlee and Perkins (1969) used additional reinforcers to instate prolonged speech or shape it towards normal fluency; apparently they relied upon the reinforcing effects of reduced stuttering to ensure that subjects would proceed through their schedules. The present schedule differs in a number of ways, but principally it establishes curbs on abnormally slow speech, a variable often associated with stuttering therapy procedures employing speech pattern techniques. Moreover, integrating

Table 3

GDAF Schedule Experiment: Pre-Stage B "probe" measure scores and number of Rating Sessions (R.Ss) necessary for non-contingent and contingent token system treated subjects to complete Stage B.

NON-CONTINGENT TOKEN SYSTEM				CONTINGENT TOKEN SYSTEM			
Subject Number	Pre-Stage B Performance		Number of R.Ss to Complete Stage B	Subject Number	Pre-Stage B Performance		Number of R.Ss to Complete Stage B
	%SS	SPM			%SS	SPM	
1	5.60	189	81	12	9.30	145	77
2	14.75	135	97	13	17.50	74	79
3	11.80	112	93	14	18.00	96	61
4	13.00	138	84	15	7.60	210	49
5	14.50	135	61	16	6.00	140	65
6	8.30	151	63	17	2.50	240	57
7	16.80	135	77	18	6.10	169	57
8	4.60	201	40	19	3.30	204	42
9	12.60	171	54	20	9.00	208	28
10	2.50	191	43	21	36.00	52	53
11	17.00	92	104	22	12.60	180	35
				23	11.00	224	38
$\bar{X}$	11.04	150.0	72.45	$\bar{X}$	11.58	161.8	53.42
SD	4.79	32.8	20.73	SD	8.73	58.8	15.28

this schedule with the token system appeared to assist subjects to attain fluency, via this system, at speech rates resembling those of normal speakers.

DISCUSSION

The present findings indicate that percentage of syllables stuttered, within an interval of conversation, is a response class that can be brought under token control. The token system used was found to modify this response class during contingent Token Schedule conditions. Increased rate of modification to this response class also occurred when penalties for relapse were combined with rewards for improvement, and when the size of rewards on the reward schedule were increased. One implication of these experiments is that the response class has utility in designing therapy procedures aimed at maintaining token control over speech behavior during the recording of lengthy periods of conversation in a variety of situations.

Another experiment described a token system schedule for instating prolonged speech with assistance from DAF procedures. Shaping of this speech pattern to fluency at prescribed rates of speech was scheduled by integrating a modification of Curlee and Perkins' (1969) procedure with a token system schedule. A comparison between a group treated by a noncontingent schedule and a matched group treated by the contingent schedule showed that the latter group completed the schedule more rapidly than the former group.

The instatement and shaping of speech patterns in stuttering therapy may be peculiarly suited to token economy conditions. Clinical experience in this laboratory with syllable-timed speech (another speech pattern that involves initial use of an unusual form of speaking) suggested that absence of adverse listener reaction and consistent use of this speech may contribute to its successful application. Token economy conditions provided an opportunity for restricting the range of listeners and ensuring

maintenance for this speech throughout the instatement shaping periods.⁶

Other variables that maintained or modified speech behavior in the present program still require clarification. For instance, in a short-term treatment program, token savings may be important. It is conceivable that high savings may accumulate to the point where duration of the program could accentuate their effect and reduce token control over behavior; adequate token savings to sustain subjects during the last days of the present program could have reduced the necessity of subjects to earn tokens.⁷ A concurrent variable that could have maintained performance was the extensive control that the program exerted over behavior. This may have been sufficiently aversive to ensure that subjects would pass through the hierarchy in Stage C, for example, in order to escape these conditions.

Since the studies reported in this paper were concluded, some further modifications have been made to the design and operation of the token economy. Subjects are now treated in groups of six, with each subject following an individually structured hierarchy of situations in Stage C. However, with the exception of the "ladies of pleasure" level, the situations that subjects reported as "difficult" are invariably embraced by those employed in Stage C of the present study.

The outcome of the treatment of the 39 subjects included in the present study was reported in another paper by the authors (Andrews and Ingham, 1972). Those findings suggested that when subjects were formally assessed nine months after completion of treatment, 65% of

⁶An alternative approach to instating and shaping prolonged speech has been suggested by Webster (1972). He has concentrated considerable attention on subjects gaining skill in the form of articulation derived from prolongation with assistance from an "online" computer programmed with a model of the desired speech pattern.

⁷Tokens savings may have a different effect on different subjects. They may act as indices of performance or, as Winkler (1971) noted, they may have reinforcing qualities independent of their original relationship to primary reinforcement.

those treated by GDAF in Stage B were recorded as free of stutter. However, that paper also alluded to problems inherent in outcome evaluations that rely on overt assessments of speech, for when covertly assessed 15 months after treatment most subjects had shown some relapse. Consequently, an additional carryover program has been added to the process and an overt/covert outcome assessment program has been scheduled to evaluate the efficacy of treatment.

Further detailed modifications to this token economy program are indicated but the present findings suggest that stuttering is suited to treatment under these conditions.

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